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NHTSA # 637850

135-TRC-05-006

SAFETY COMPLIANCE TESTING FOR FMVSS 135
Passenger Car Brake Systems

Volvo Gothenburg Sweden
2005 Volvo S40 2.4I M, 4-Door Sedan
NHTSA No. C55900

TRANSPORTATION RESEARCH CENTER INC.
10820 State Route 347
East Liberty, Ohio 43319

Final Report Completed: May 20, 2005

FINAL REPORT

Prepared Under Contract No.: DTNH22-01-C-21025

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
400 Seventh Street, SW
Room 6115 (NVS-220)
Washington, DC 20590

Prepared for the Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-01-C-21025.

Prepared By _____

Approved By _____

Approval Date: 5/23/05

Final Report Acceptance By OVSC:

_____

Contract Technical Manager, Office of Vehicle Safety Compliance

6/3/05

_____

Acceptance Date

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4. TITLE AND SUBTITLE: Final report of FMVSS 135 Compliance Testing of a 2005 Volvo S40 2.4I M, 4-Door Sedan, NHTSA No. C55900		5. REPORT DATE: May 20, 2005 6. PERFORMING ORGANIZATION CODE: TRC 20000113/5355
7. AUTHOR(S): Project Manager: WALTER DUDEK Project Engineer: RANDALL A. LANDES		8. PERFORMING ORGANIZATION REPORT NO.: TRC-DOT-135-062
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Transportation Research Center Inc. 10820 State Route 347 East Liberty, Ohio 43319		10. WORK UNIT NUMBER: 11. CONTRACT OR GRANT NO.: DTNH22-01-C-21025
12. SPONSORING AGENCY NAME AND ADDRESS: U.S. Department of Transportation National Highway Traffic Safety Administration Enforcement Office of Vehicle Safety Compliance (NVS-220) 400 Seventh Street, SW, Room 6115 Washington, DC 20590		13. TYPE OF REPORT AND PERIOD COVERED: Final test report Tested: 04/21/05 to 05/11/05 14. SPONSORING AGENCY CODE: NVS-220
15. SUPPLEMENTARY NOTES:		
16. ABSTRACT: Compliance tests were conducted on the subject 2005 Volvo S40 2.4I M, 4-Door Sedan, in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-135-00 for the determination of FMVSS 135 compliance. Test failures identified were as follows: None.		
17. KEY WORDS: Compliance Testing Safety Engineering FMVSS 135		18. DISTRIBUTION STATEMENT: Copies of this report are available from: NHTSA Technical Reference Division Mail Code: NAD-40 400 Seventh Street, SW, Rm. 5108 Washington, DC 20590 Telephone No. (202) 366-4949
19. SECURITY CLASSIF. (OF THIS REPORT): Unclassified	20. SECURITY CLASSIF. (OF THIS PAGE). Unclassified	21. NO. OF PAGES: 76 / 22. PRICE:

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1.0 INTRODUCTION

Tests were conducted on a 2005 Volvo S40 2.4I M, 4-Door Sedan, manufactured by Volvo Gothenburg Sweden, to determine compliance with FMVSS 135 "Passenger Car Brake Systems." All tests were conducted in accordance with the U.S. D.O.T., NHTSA Laboratory Procedure TP 135-00 and/or the corresponding TRC Inc. Test Procedure that was submitted to NHTSA for their approval. The Test Procedure was clearly described in the submitted document and has not been repeated in this report.

All stops were performed manually.

All tests were conducted by TRC Inc. personnel using the following TRC facilities:

7.5-Mile Test Track
Vehicle Maximum Speed
Burnish
Heating Snubs and Hot Performance Stops
Brake Cooling and Recovery Stops

Skid Pad
Cold Effectiveness Stops
High Speed Effectiveness Stops
Stops with Engine Off
Failed Antilocks
Failed Variable Proportioning Valve (if applicable)
Failed Hydraulic Circuits
Brake Power Assist Unit Failures
RBS Failure (if applicable)
EMF (Battery) Failure (if applicable)

Brake Slope
Parking Brake

Average PFC during the test period was 0.96 (Skid Pad) and 0.93 (Test Track) utilizing the ASTM E1337 w/E1336 tire method.

The test vehicle was ABS equipped. Therefore, the Wheel Lock Sequence and Adhesion Utilization Tests were not performed.

This vehicle met the requirements of FMVSS 135.

DATA SHEET 1 - VEHICLE INFORMATION

VEHICLE SPECS

Year:	2005	NHTSA No:	C55900
Mfr:	VOLVO GOTHENBURG SWEDEN	GVWR (Kg):	1959.6
Make:	VOLVO	GAWR Front(Kg):	1079.6
Model:	S40 2.4I M	GAWR Rear(Kg):	966.0
Body Style:	4-DOOR SEDAN	Wheelbase (mm):	2628.9
Mfr. Date:	06/04	Odometer:	Start:51 MI. End:507 MI.
VIN:	YV1MS382152051631		

BUSES ONLY

Chassis Mfg.:	N/A
Serial No.:	N/A
No. of Seats:	N/A
Manufacture Date:	N/A

Engine Type:	GASOLINE,I-5 CYL.,DOHC,VARIABLE VALVE TIMING,PISTON.		
Displacement:	2.4 LITER	Tire Size:	205/55R16
Engine Hspwr:	N/A	Tire Type:	ENERGY MXV4,91V,S8,M&S,RADIAL
Idle Speed(rpm):	756	Tire Mfr.:	MICHELIN
Transmission Type:	5-SPEED MANUAL, FWD	GVWR Front Press.(kpa):	248.21
No. of Axles:	2	GVWR Rear Press.(kpa):	248.21

BRAKE APPLY SYSTEM

Brake Series:	Front:DISC Rear:DISC	Power Assist Unit:	YES
Brake Actuation (Hydr. Circuit Split):	DIAGONAL	Pwr Unit w/Accumulator:	NO
Power Unit:	VACUUM	Pwr Asst./Pwr Unit w/Backup:	NO
Anti-Skid unit Mfr:	TEVES	Variable Prop. System:	NO
Parking Mechanism:	NO	Anti-Skid Device:	YES
Type of Parking Unit:	N/A		
Mstr Cylinder Dia(mm):	See Appendix C.	Pedal Ratio:	3.7:1 IN

FRONT SYSTEM BRAKE COMPONENT MATERIALS AND CONSTRUCTION:

BRAKE TYPE:	DISC	Material:	CAST
Drum Construction:	N/A	LF Drum Shoe Cage Dia.(mm):	0.00
Disc Construction:	INTEGRAL CAST,VENTED	RF Drum Shoe Cage Dia.(mm):	0.00
Front Brake Dia.(mm):	300.18	LF Drum Dia. RESET(mm):	0.00
Fr Disc Thickness(mm):	25.02	RF Drum Dia. RESET(mm):	0.00
Lining Construction:	Bonded		

FRONT BRAKE COMPONENT DIMENSIONS AND CODES:

Inboard (Leading)		Outboard (Trailing)	
Width(mm):	58.39	Width(mm):	58.19
Length(mm):	105.74	Length(mm):	105.69
Thickness(mm):	11.63	Thickness(mm):	11.53
Lining Code/Color:	F 4198 FF	Lining Code/Color:	F 4198 FF
Hyd. Piston Dia.(mm):	56.92		

DATA SHEET 1 - (CONTINUED)

REAR SYSTEM BRAKE COMPONENT MATERIALS AND CONSTRUCTION:

BRAKE TYPE: DISC
Drum Construction: N/A
Disc Construction: INTEGRAL CAST
Lining Construction: BONDED
Rear Brake Dia.(mm): 279.65
Rr Disc Thickness(mm): 10.87

Material: CAST IRON
LR Drum Shoe Cage Dia.(mm): 0.00
RR Drum Shoe Cage Dia.(mm): 0.00
LR Drum Dia. RESET(mm): 0.00
RR Drum Dia. RESET(mm): 0.00

REAR BRAKE COMPONENT DIMENSIONS AND CODES:

Inboard (Leading)
Width(mm): 40.72
Length(mm): 77.93
Thickness(mm): 10.77
Lining Code/Color: 4132 FF
Hyd Piston Dia (mm): 37.92

Outboard (Trailing)
Width (mm): 40.69
Length (mm): 77.85
Thickness (mm): 10.39
Lining Code/Color: 4132 FF

OTHER COMPONENT INFORMATION:

Friction-type Park Brake: N/A
Non-Service Brake Type
Parking Brake: HAND OPERATED.

NOTE: If at any time after the test series has begun, any brake system part requires replacement or the brake system requires adjustments other than permitted in burnish and reburnish procedures, discontinue testing and notify the COTR immediately.

Technician: Karen Easterday Date: 05-24-05
KAREN EASTERDAY

Quality Assurance: Ken Webster
KEN WEBSTER

VEHICLE: 2005 Volvo S40 2.4l M NHTSA NO.: C55900 DATE: 05/20/05

3.0 SUMMARY OF TESTING

		Specification and Limit				TEST RESULTS (In compliance if one stop meets requirement)			
TEST	Loading Condition	Speed (km/h)	Min. Pedal Force (N)	Max. Pedal Force (N)	Stopping Distance Requirement (m)	Shortest Stop Min. Pedal Force (N)***	Shortest Stop Max. Pedal Force Newtons (Average – N)	Shortest Stop Stopping Distance (m) (Corrected)	PASS Fail
Equipment Requirements					Specified Equipment	Vehicle contains specified equipment			Pass
Vehicle Maximum Speed	LLVW	NA				207.2 km/h avg.			NA
Burnish	GVWR	80				200, 80 - 0 km/h stops @ 3.0 mpsps			NA
Wheel Lockup Sequence w/o ABS	GVWR				Lockup of front wheels prior to rear	ABS Equipped			NA
Wheel Lockup Sequence w/o ABS	LLVW					ABS Equipped			NA
Adhesion Utilization w/o ABS	LLVW				Rear axle adhesion utilization curve below specified value	ABS Equipped			NA
Adhesion Utilization w/o ABS	GVWR					ABS Equipped			NA
Cold Effectiveness	GVWR	100	65	500	70	5	471.8	47.3	Pass
High Speed Effectiveness	GVWR	160.0	65	500	spd. depend. – 187.5	5	480.9	115.4	Pass
Stops with Engine Off	GVWR	100	65	500	70	5	404.5	44.8	Pass
Cold Effectiveness	LLVW	100	65	500	70	5	453.9	43.9	Pass
High Speed Effectiveness	LLVW	160.0	65	500	spd. depend. – 187.5	5	489.9	109.3	Pass
Failed Antilock	LLVW	100	65	500	70	5	230.0	55.2	Pass
Failed Proportioning Valve	LLVW	100	65	500	110	5	NA	NA	NA
Failed Hydraulic Circuit #1	LLVW	100	65	500	168	5	468.1	87.2	Pass
Failed Hydraulic Circuit #2	LLVW	100	65	500	168	5	493.6	89.3	Pass
Failed Hydraulic Circuit #1	GVWR	100	65	500	168	5	476.2	93.7	Pass
Failed Hydraulic Circuit #2	GVWR	100	65	500	168	5	485.6	94.0	Pass
Failed Antilock	GVWR	100	65	500	70	5	228.4	53.2	Pass
Failed Proportioning Valve	GVWR	100	65	500	110	5	NA	NA	NA
Regenerative Brake System (RBS) Failure	GVWR	100	65	500	168	5	NA	NA	NA
Electromotive Force (EMF) – Battery Failure	GVWR	100	65	500	70	5	NA	NA	NA
Power Brake Unit Failure	GVWR	100	65	500	168	5	495.9	142.5	Pass
Parking Brake - Uphill	GVWR	-	-	400	Hold for 5 min.?	NA	321.2	Yes-Holds	Pass
Parking Brake - Downhill	GVWR	-	-	400	Hold for 5 min.?	NA	320.9	Yes-Holds	Pass
Heating Snubs	GVWR	120-60	NA	NA	15 Snubs- 3.0 mpsps	5	48 Vis. Avg.	NA	NA
Hot Performance Stop #1	GVWR	100	65	364.7 avg.	72.2	5	376.6 (271.0)	46.7	Pass
Hot Performance Stop #2	GVWR	100	65	500	70	5	464.0 (358.8)	46.8	Pass
Brake Cooling	GVWR	80	NA	NA	4 Stops - 3.0 mpsps	5	45 Vis. Avg.	NA	NA
Recovery Performance Stop #1	GVWR	100	65	364.7 ~~384.3~~ avg.	One of the two stops between 63.3 and 34.9 meters	5	378.8 (263.9)	47.8	Pass
Recovery Performance Stop #2	GVWR	100	65	364.7 384.3 avg.		5	366.2 (272.9)	46.4	
Final Inspection-Brake Integrity	Check components for detachment, fracture or lubricants.					No detachments or fractures-normal appear. & colr.			Pass
Final Inspection-Reservoirs/Warning Indicators	Master cylinder or brake power reservoir shall meet the volume and label requirements of S5.4.2 and S5.4.3.					Brake system has sufficient capacity and indicators are in compliance.			Pass

*** Note: The Shortest Stop Minimum Pedal Force represents the minimum force value required to engage the data acquisition's recording mode.

DATA SHEET 3 - VEHICLE WEIGHT

VEHICLE: 2005 VOLVO S40 2.4I M NHTSA No. C55900 Date: 04/25/05

Tire Pressure(cold): Front (kpa) 248 Rear (kpa) 248
Odometer: Start 51 MI. End 507 MI.
Scale(s) Used: TRC Scales

NOTE: GVWR, LLVW and axle weights to be measured within +0% and -1%.

GVWR/GAWR INFORMATION
(From Veh. Certification Label)

GVWR(Kg): 1960
GAWR Front(Kg): 1080
GAWR Rear(Kg): 966

UNLOADED VEHICLE WEIGHT(UVW)

L Front(Kg): 419 L Rear(Kg): 299
R Front(Kg): 430 R Rear(Kg): 287
T Front(Kg): 848 T Rear(Kg): 586
Total UVW(Kg): 1434

TARGET LIGHT LOADED WEIGHT(LLVW):

NOTE 1: LLVW = UVW+181.4Kg
NOTE 2: Weight distributed in front passenger seat area.
NOTE 3: Neither axle load at LLVW less than at UVW; ballast as required.

L Front(Kg): 466 L Rear(Kg): 342
R Front(Kg): 478 R Rear(Kg): 331
T Front(Kg): 943 T Rear(Kg): 673
Total LLVW(Kg): 1617

ACTUAL LIGHT LOADED WEIGHT(LLVW)

L Front(Kg): 470 L Rear(Kg): 344
R Front(Kg): 473 R Rear(Kg): 328
T Front(Kg): 943 T Rear(Kg): 672
Total Actual Test LLVW(Kg): 1615

Load: Driver/Observer 73(Kg) + Instru.41(Kg) + Ballast 68(Kg) = 181(Kg)

FULLY LOADED TEST WEIGHT (ACTUAL GVWR)

NOTE 1: Vehicle loaded so axle loads proportional to GAWR shown previously.
NOTE 2: But no axle weight to be less than at LLVW.
NOTE 3: If weight on any axle at LLVW exceeds the axle's proportional share of the GVWR, the load required to reach GVWR is placed so that the weight on that axle remains the same as at LLVW.

L Front(Kg): 501 L Rear(Kg): 462
R Front(Kg): 533 R Rear(Kg): 463
T Front(Kg): 1034 T Rear(Kg): 925
Total Fully Loaded GVWR(Kg): 1960

Load: Driver/Observer 73(Kg) + Instru. 41(Kg) + Ballast 412(Kg)= 525(kg)

Technician: Karen Easterday Date: 05-24-05
KAREN EASTERDAY

Quality Assurance: Ken Webster
KEN WEBSTER

DATA SHEET 4 - EQUIPMENT REQUIREMENTS (S5)

SERVICE BRAKE SYSTEM (S5.1)

Vehicle equipped with a service brake system acting on all wheels? YES

Wear Adjustment (S5.1.1):
Service Brakes are compensated for wear by means of a system of automatic adjustment? YES
Describe: DISC-AUTOMATIC CLEARANCE TAKE-UP.

Wear Status (S5.1.2):
Wear status of service brakes is indicated by:
(A) Acoustic or optical device? NO
Describe: N/A
(B) Visual check outside or under vehicle? YES
Describe: FRONT & REAR:LOOK THROUGH CALIPER.

PARKING BRAKE SYSTEM (S5.2)

Vehicle equipped with a parking brake system of a friction type with solely mechanical means to retain engagement: YES

CONTROLS (S5.3)

(A) Service brakes activated by means of a foot control? YES
(B) Parking brake control is independent of the service brake control? YES
(C) Parking brake control is hand or foot operated? YES
(D) ABS, if equipped, cannot be manually disabled? YES

DATA INDICATES COMPLIANCE: YES

COMMENTS: NONE.

Tester/Technician: Karen Easterday Date: 05-24-05
KAREN EASTERDAY

Quality Assurance: Ken Webster
KEN WEBSTER

DATA SHEET 5 - VEHICLE MAX SPEED

VEHICLE: 2005 VOLVO S40 2.4I M NHTSA No. C55900 Date: 04/25/05

Ambient Temperature: 49°F Wind Velocity: 13(MPH)
Road PFC: .93 Wind Direction: 152°
Odometer: Start 345(mi) End 361(mi)

TEST WEIGHT: Total (Kg): 1615 Front (Kg): 943 Rear (Kg): 672

ESTABLISH VEHICLE MAXIMUM SPEED

VEHICLE LOAD: LLVW
GEAR: Drive
PEDAL FORCE: N/A
TEST SPEED: Maximum attainable from a standing start in 3.2 km.

IBT: N/A
DECEL RATE: N/A
WHEEL LOCKUP: N/A
INTERVAL: N/A

1. Ballast Vehicle to LLVW
2. Accelerate at a maximum rate from a standing start for a distance of 3.2 km on a level surface.
3. Repeat in opposite direction.
4. Record speed attained in each direction and use the average of the two runs.

	DIRECTION	MAX SPEED (km/h)		Time 0 - 100 KPH (seconds)
		Visual	Recorded	
Run No. 1	South	202.6 kph	202.7	12.12
Run No. 2	North	211 kph	211.7	11.00

AVERAGE = 207.2 km/h

COMMENTS: INV DATA, Section 0001, 04/26/05, 09:04:40

Tester/Technician: Karen Easterday Date: 05-24-05
KAREN EASTERDAY

Quality Assurance: Ken Webster
KEN WEBSTER

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 04/25/05

DATA SHEET 6 - BURNISH AT GVWR

Testing Conditions: INV DATA, Section 0002, 04/25/05, 16:18:11

Weather Conditions: 50°F Wind: 7 mph 165°

Start Odo.: 75 End Odo.: 331

Schedule:
Initial Brake Temperature Less Than 100°C
Initial Speed 80 km/h to zero
200 stops with transmission in gear

Performance Requirements:
Interval between runs: Time necessary to reduce IBT to 100 C° or 2 km distance, whichever occurs first.
Constant decel rate: 3.0 m/s^2
Pedal force adjusted to maintain constant decel.
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	AVG. DECEL (m/sec^2)
1	81.05	82	79	72	74	69.96	57.45	2.70
10	81.00	94	99	92	92	72.15	58.97	2.63
20	80.14	92	94	96	100	67.04	56.35	2.72
30	80.00	88	86	94	104	78.30	65.21	2.76
40	80.47	84	92	102	101	66.98	54.25	2.79
50	80.69	85	91	100	103	65.76	50.11	2.79
60	79.79	86	87	99	109	66.82	57.63	2.81
70	80.76	83	93	106	102	75.62	58.21	2.73
80	79.93	85	91	102	104	64.33	49.87	2.86
90	79.72	86	87	102	108	63.48	54.43	2.89
100	79.93	83	90	104	106	68.89	47.77	2.83
110	79.83	86	88	102	112	68.71	55.41	2.62
120	80.35	83	87	102	112	75.44	49.90	2.72
130	80.78	83	86	102	110	68.38	48.74	2.70
140	79.83	81	87	102	107	63.69	54.89	2.74
150	79.33	81	86	95	104	67.13	51.88	2.81
160	80.27	82	86	98	107	61.41	53.19	2.72
170	80.90	79	86	97	108	66.98	52.52	2.66
180	80.07	80	87	97	104	64.21	48.98	2.66
190	80.12	82	87	98	107	64.88	50.45	2.72
200	80.60	79	87	99	107	65.91	52.39	2.75

COMMENTS: THIS VEHICLE AES EQUIPPED. DATA SHEETS 7-10 NOT INCLUDED.

BRAKE ADJUSTMENT

Schedule:
Adjust service brakes; record procedure and amount adjusted.

Left Front: DISC DISC BRAKE NO ADJUSTMENT REQUIRED
Right Front: DISC DISC BRAKE NO ADJUSTMENT REQUIRED
Left Rear: DISC DISC BRAKE NO ADJUSTMENT REQUIRED.
Right Rear: DISC DISC BRAKE NO ADJUSTMENT REQUIRED.
DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEESTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 04/28/05

DATA SHEET 11 - COLD EFFECTIVENESS AT GVWR

Testing Conditions: INV DATA, Section 0015, 04/28/05, 10:02:37

Weather Conditions: 44°F Wind: 9 mph 322° Start Odo.: 367 End Odo.: 372

Schedule:
Initial Brake Temperature 65 - 100 C
Initial Speed 100 km/h to zero
6 stops with transmission in neutral

Performance Requirements:
One Stop with:
Stopping Distance less than 70m
Pedal force between 65N and 500N
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	100.88	72	74	68	67	50.2	49.4	484.19	373.07	11.15	7.01
2	99.92	81	81	65	64	47.4	47.5	502.32	400.04	11.29	7.55
3	100.28	88	88	72	72	47.9	47.6	508.80	370.57	11.71	7.54
4	100.96	90	93	74	76	49.0	48.1	458.04	351.69	12.52	7.51
5	99.48	91	94	76	76	46.9	47.4	481.12	363.27	11.39	7.39
6	99.99	89	94	74	73	47.3	47.3	471.76	364.67	11.27	7.23

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock up - Direction of Stop - Stay in Lane)			
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES
5	-	NOX	SOUTH	YES
6	-	NOX	SOUTH	YES

Corrected Distances are used to determine shortest stopping distance.

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 04/28/05

DATA SHEET 12 - HIGH SPEED EFFECTIVENESS AT GVWR

Testing Conditions: INV DATA, Section 0020, 04/28/05, 10:35:12

Weather Conditions: 45°F Wind: 2 mph 258° Start Odo: 373 End Odo: 384

Schedule:
Initial Brake Temperature: 65-100°C
Initial Speed: 80% max km/h, not greater than 160km/h
6 stops with transmission in gear

Performance Requirements:
One Stop with:
Stopping Distance less than: 187.5 meter
Pedal force between 65N and 500N
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	158.88	64	67	40	42	120.4	122.1	499.10	384.08	13.84	7.94
2	159.38	87	88	56	58	119.7	120.6	499.34	364.46	15.91	7.79
3	159.69	86	93	50	55	118.4	118.9	468.59	351.11	14.61	7.86
4	158.12	91	94	50	55	117.5	120.3	506.88	337.58	13.19	8.18
5	160.04	89	93	49	51	116.0	116.0	486.41	370.03	15.28	8.32
6	159.49	79	81	41	43	114.7	115.4	480.94	356.71	13.91	7.99

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock up - Direction of Stop - Stay in Lane)			
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES
5	-	NOX	SOUTH	YES
6	-	NOX	SOUTH	YES

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 04/28/05

DATA SHEET 13 - STOPS WITH ENGINE OFF AT GVWR

Testing Conditions: INV DATA, Section 0025, 04/28/05, 12:03:52

Weather Conditions: 46°F Wind: 1 mph 72° Start Odo.: 388 End Odo.: 396

Schedule:
Initial Brake Temperature: 65-100°C
Initial Speed 100 km/h to zero
6 stops with transmission in neutral

Performance Requirements:
One Stop with:
Stopping Distance less than 70m
Pedal force between 65N and 500N
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	100.62	69	69	58	57	48.6	48.0	355.19	254.25	16.01	7.47
2	100.47	87	88	69	69	47.0	46.6	439.09	321.52	16.21	7.47
3	99.93	88	87	74	77	46.9	47.0	460.23	306.10	15.53	7.37
4	100.48	94	94	80	84	45.2	44.8	404.51	336.03	11.55	7.85
5	99.83	82	86	65	66	47.6	47.8	422.34	341.47	12.11	7.68
6	100.11	92	95	73	77	45.9	45.8	419.20	320.70	11.94	7.72

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)			
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES
5	-	NOX	SOUTH	YES
6	-	NOX	SOUTH	YES

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 04/28/05

DATA SHEET 14 - COLD EFFECTIVENESS AT LLVW

Testing Conditions: INV DATA, Section 0030, 04/28/05, 13:47:03

Weather Conditions: 53°F Wind: 12 mph 251° Start Odo.: 399 End Odo.: 404

Schedule:
Initial Brake Temperature: 65-100°C
Initial Speed 100 km/h to zero
6 stops with transmission in neutral

Performance Requirements:
One Stop with:
Stopping Distance less than 70m
Pedal force between 65N and 500N
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	100.12	70	70	62	57	45.2	45.1	472.27	355.73	12.34	8.04
2	100.71	83	81	57	53	44.3	43.7	502.35	380.79	12.56	8.01
3	99.61	94	91	59	57	45.4	45.8	447.67	282.07	13.39	7.90
4	99.20	76	71	45	42	45.9	46.6	443.50	297.92	12.42	7.73
5	101.00	88	81	52	50	44.8	43.9	453.87	364.13	13.52	7.86
6	98.83	92	83	49	48	44.3	45.4	481.46	364.31	13.16	7.66

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)		
1	- NOX	SOUTH	YES
2	- NOX	SOUTH	YES
3	- NOX	SOUTH	YES
4	- NOX	SOUTH	YES
5	- NOX	SOUTH	YES
6	- NOX	SOUTH	YES

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 04/28/05

DATA SHEET 15 - HIGH SPEED EFFECTIVENESS AT LLVW

Testing Conditions: INV DATA, Section 0035, 04/28/05, 14:25:47

Weather Conditions: 54°F Wind: 11 mph 272° 8tart Odo.: 405 End Odo.: 414

Schedule:
Initial Brake Temperature: 65-100°C
Initial Speed: 80% max km/h
6 stops with transmission in gear

Performance Requirements:
One Stop with:
Stopping Distance less than 187.5m
Pedal force between 65N and 500N
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	159.27	79	67	39	37	110.9	111.9	475.22	386.39	13.95	8.31
2	158.70	81	66	37	29	108.5	110.3	483.37	390.10	15.61	8.41
3	161.35	74	59	34	27	111.2	109.3	489.85	370.33	16.04	8.36
4	158.00	80	66	39	31	111.4	114.2	456.43	383.32	16.08	8.31
5	159.85	91	79	43	34	110.2	110.4	494.72	379.15	15.72	8.50
6	158.93	91	80	42	34	109.4	110.9	480.15	375.47	15.99	8.56

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)			
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES
5	-	NOX	SOUTH	YES
6	-	NOX	SOUTH	YES

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Fressure: 248 (Kpa)

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Date Tested: 04/29/05

DATA SHEET 16 - ANTILOCK FUNCTIONAL FAILURE AT LLVW

Testing Conditions: INV DATA, Section 0040, 04/29/05, 08:58:36

Weather Conditions: 49°F Wind: 2 mph 162° Start Odo.: 418 End Odo.: 418

Schedule:
Initial Brake Temperature: 65-100°C
Initial Speed 100 km/h to zero
6 stops with transmiseion in neutral

Performance Requirements:
One Stop with:
Stopping Distance less than 85m
Pedal force between 65N and 500N
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	99.92	64	66	71	66	59.5	59.6	197.21	113.14	12.07	6.17
2	99.56	73	76	69	63	62.3	62.9	149.50	125.73	9.33	6.12
3	101.40	86	86	76	71	57.5	56.0	181.76	129.34	9.28	6.44
4	100.40	93	93	80	77	55.6	55.2	230.01	110.83	11.37	6.31
5	100.31	76	77	56	53	54.0	53.7	185.38	87.60	12.30	6.41
6	98.73	84	86	65	61	64.9	66.6	155.98	122.53	8.57	6.02

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)			
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES
5	-	RRX-MID	SOUTH	YES
6	-	NOX	SOUTH	YES

How was the ABS failure induced: REMOVED 20 AMP FUSE FROM BOX UNDER HOOD, LEFT SIDE.

Is brake system indicator lamp activated: YES (X) NO ( )

Vehicle not equipped with variable proportioning valve. Data Sheet 17 not included.

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 04/29/05

DATA SHEET 18 - HYDRAULIC CIRCUIT FAILURE #1 AT LLVW

Testing Conditions: INV DATA, Section 0050, 04/29/05, 10:49:08

Weather Conditions: 51°F Wind: 2 mph 52° Start Odo.: 422 End Odo.: 426

Method of simulating failure: Disconnected Brake Line @ M/C Front Port

System Portion Failed: LF & RR

Schedule:
Initial Brake Temperature: 65-100°C
Initial Speed 100 km/h to zero
4 stops with transmission in neutral

Performance Requirements:
One Stop with:
Stopping Distance less than 168m
Pedal force between 65N and 500N
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	100.07	25	84	73	21	89.7	89.5	451.76	364.56	8.91	4.14
2	100.60	24	94	62	19	88.3	87.2	468.06	385.39	7.38	4.12
3	99.76	23	85	48	18	90.0	90.5	475.75	397.85	8.47	4.04
4	99.16	22	78	42	17	89.9	91.4	493.63	393.84	9.18	4.05

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)			
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES

Force Needed to Activate Brake Failure Lamp (N): N/A
Fluid Removed (mL) to Activate Brake Failure Lamp: 166

Is brake system indicator lamp activated: YES (X) NO ( )

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 04/29/05

DATA SHEET 19 - HYDRAULIC CIRCUIT FAILURE #2 AT LLVW

Testing Conditions: INV DATA, Section 0055, 04/29/05, 13:14:50

Weather Conditions: 52°F Wind: 3 mph 79° Start Odo.: 430 End Odo.: 434

Method of simulating failure: Disconnected Brake Line @ M/C Rear Port

System Portion Failed: RF & LR

Schedule:
Initial Brake Temperature 65-100°C
Initial Speed 100 km/h to zero
4 stops with transmission in neutral

Performance Requirements:
One Stop with:
Stopping Distance less than 168m
Pedal force between 65N and 500N
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	99.72	73	26	21	66	94.2	94.7	392.38	312.60	11.46	4.16
2	99.23	80	24	19	54	90.2	91.6	466.26	392.07	8.18	4.25
3	99.21	93	24	18	62	87.9	89.3	493.57	408.34	9.26	4.29
4	100.22	81	23	18	49	90.0	89.6	482.10	417.04	7.65	4.26

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)		
1	- NOX	SOUTH	YES
2	- NOX	SOUTH	YES
3	- NOX	SOUTH	YES
4	- NOX	SOUTH	YES

Force Needed to Activate Brake Failure Lamp (N): N/A
Fluid Removed (mL) to Activate Brake Failure Lamp: 166

Is brake system indicator lamp activated: YES (X) NO ( )

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 04/29/05

DATA SHEET 20 - HYDRAULIC CIRCUIT FAILURE #1 AT GVWR

Testing Conditions: INV DATA, Section 0060, 04/29/05, 15:30:53

Weather Conditions: 52°F Wind: 3 mph 28° Start Odo.: 444 End Odo.: 448

Method of simulating failure: Disconnected Brake Line @ M/C Front Port

System Portion Failed: LF & RR

Schedule:
Initial Brake Temperature 65-100°C
Initial Speed 100 km/h to zero
6 stops with transmission in neutral

Performance Requirements:
One Stop with:
Stopping Distance less than 168m
Pedal force between 65N and 500N
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE J299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	100.29	38	73	79	32	100.1	99.6	478.64	403.17	5.76	3.83
2	99.69	32	80	58	27	98.4	99.0	517.95	408.04	11.00	4.00
3	99.30	29	93	64	24	92.8	94.1	469.91	397.73	6.58	3.96
4	100.70	28	89	61	22	95.0	93.7	476.21	396.60	6.40	3.89

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)			
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES

Is brake system indicator lamp activated: YES (X) NO ( )

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 04/29/05

DATA SHEET 21 - HYDRAULIC CIRCUIT FAILURE #2 AT GVWR

Testing Conditions: INV DATA, Section 0065, 04/29/05, 14:12:15

Weather Conditions: 52°F Wind: 1 mph 16° Start Odo.: 437 End Odo.: 441

Method of simulating failure: Disconnected Brake Line @ M/C Rear Port

System Portion Failed: RF & LR

Schedule:
Initial Brake Temperature 65-100°C
Initial Speed 100 km/h to zero
4 stops with transmission in neutral

Performance Requirements:
One Stop with:
Stopping Distance less than 168m
Pedal force between 65N and 500N
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	99.46	86	24	19	68	93.4	94.4	481.34	401.04	6.74	4.00
2	99.89	96	25	19	76	93.8	94.0	497.15	421.54	6.76	3.96
3	100.80	89	27	18	61	95.6	94.0	485.60	415.24	8.08	4.08
4	99.02	93	27	18	72	95.1	96.9	494.51	412.05	7.75	3.94

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)		
1	- NOX	SOUTH	YES
2	- NOX	SOUTH	YES
3	- NOX	SOUTH	YES
4	- NOX	SOUTH	YES

Is brake system indicator lamp activated: YES (X) NO ( )

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Teated: 05/02/05

DATA SHEET 22 - ANTILOCK FUNCTIONAL FAILURE AT GVWR

Testing Conditions: INV DATA, Section 0070, 05/02/05, 09:18:21

Weather Conditions: 41°F Wind: 18 mph 301° Start Odo.: 455 End Odo.: 455

Schedule:
Initial Brake Temperature 65-100°C
Initial Speed 100 km/h to zero
6 stops with transmission in neutral

Performance Requirements:
One Stop with:
Stopping Distance less than 85m
Pedal force between 65N and 500N
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec^2)	AVG. DECEL (m/aec^2)
1	99.92	77	78	78	76	58.8	58.9	150.87	118.85	8.51	6.43
2	100.65	85	86	79	76	56.2	55.5	209.74	130.88	9.44	6.80
3	100.44	93	91	81	78	61.2	60.7	202.49	142.08	8.85	6.44
4	99.43	95	87	73	72	52.6	53.2	228.42	109.90	9.79	6.78
5	100.59	84	81	59	54	54.6	54.0	201.85	103.45	9.41	6.91
6	100.91	89	86	67	60	65.9	64.7	181.25	132.98	8.37	6.17

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)		
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES
5	-	NOX	SOUTH	YES
6	-	NOX	SOUTH	YES

How was the ABS failure induced: REMOVED 20 AMP FUSE FROM BOX UNDER HOOD, LEFT SIDE.

Is brake system indicator lamp activated: YES (X) NO ( )

Vehicle not equipped with variable proportioning valve. Data Sheet 23 not included.

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 05/02/05

DATA SHEET 24 - BRAKE POWER UNIT OR PWR ASSIST UNIT IN/OP AT GVWR

Testing Conditions: INV DATA, Section 0080, 05/02/05, 10:54:47

Weather Conditions: 43°F Wind: 16 mph 260° Start Odo.: 461 End Odo.: 468

Failure Simulation: Disconnect primary source of power.

Method of rendering inoperative: Removed Vacuum Pump Hose at Booster.

Schedule:
Initial Brake Temperature 65-100°C
Initial Speed 100 km/h to zero
6 stops with transmission in neutral

Performance Requirements:
One Stop with:
Stopping Distance less than 168m
Pedal force between 65N and 500N
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	99.84	86	82	74	77	146.5	147.0	483.20	459.89	3.84	2.73
2	99.41	84	83	72	68	149.1	150.9	497.45	460.86	4.87	2.76
3	98.91	88	83	72	69	139.4	142.5	495.93	470.45	3.86	2.85
4	99.46	79	74	53	51	143.2	144.8	490.72	467.10	3.76	2.79
5	100.27	88	82	65	61	146.0	145.2	492.91	447.02	3.61	2.75
6	99.52	77	71	61	61	133.7	135.0	507.22	477.85	3.69	2.93

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)		
1	- NOX	SOUTH	YES
2	- NOX	SOUTH	YES
3	- NOX	SOUTH	YES
4	- NOX	SOUTH	YES
5	- NOX	SOUTH	YES
6	- NOX	SOUTH	YES

Is the brake system indicator lamp activated: YES ( ) NO (X)

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Maks: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 05/02/05

DATA SHEET 25 - PARKING BRAKE AT GVWR

Testing Conditions: INV DATA, Section 0085, 05/02/05, 13:11:09
Parking brake: N/A Non-service type: HAND OPERATED. Service type: N/A

Weather Conditions: 44°F Wind: 11 mph 294° Start Odo.: 470 End Odo.: 470

Test Weight: Total:1960kg Front:1034kg Rear: 925kg

Schedule:
Initial Brake Temperature <100°C or (Ambient temp. if non-service brake type materials)
Loaded to GVWR with transmission in neutral
Drive onto 20% slope in forward and reverse directions.

Performance Requirements:
Up to Three Applies in each direction:
Parking brake must hold the vehicle stationary in both directions for 5 minutes each.
Pedal force: Hand control: <400 N
Foot control: <500 N

NOTE: For vehicles with parking brake systems not utilizing the service brake friction elements, the friction elements of such systems are to be burnished prior to parking brake tests according to the manufacturer's published recommendation as furnished to the purchaser. If no recommendations are furnished, test the system in an unburnished condition. If recommendations are furnished, record method used.

APPLY #	MAX SERVICE FORCE (N)	MAX P-BRAKE FORCE (N)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	AVG REAR IBT (°C)	DRIVER VEHICLE STOP COMMENTS (Direction of Stop (Up/Down) - Brake holds/fails)			
1	104.9	321.2	18	19	18.6	- 0 REAPPLY	UPHILL	HOLDS	20%
2	141.7	320.9	23	24	23.3	- 0 REAPPLY	DOWNHILL	HOLDS	20%

Is brake system indicator lamp activated: YES (X) NO ( )

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 05/03/05

DATA SHEET 26 - HEATING SNUBS AT GVWR

Testing Conditions: INV DATA, Section 0090, 05/03/05, 11:00:30

Schedule:

Conduct 15 snubs from 120 Km/h or 80% Vmax, whichever is slower, to 1/2 of initial speed.
Attain required decel in 1 second and maintain that decel.
Interval between snubs is 45 seconds and WOT to initial speed.

Performance Requirements:

Initial IBT for first snub is 55-65°C
Maintain 3.0 m/s/s deceleration
Vehicle Must stay in lane of 3.5m

SNUB #	AVG. DECEL (m/sec^2)	Time Between Snubs (second)	AVG. PEDAL FORCE (N)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	INIT SPD (kph)
1	2.93	--NA--	54.63	48	51	52	57	121.06
2	2.92	46	48.67	81	85	84	93	120.84
3	2.80	44	50.22	112	118	119	130	119.81
4	2.86	45	45.68	137	148	146	156	120.96
5	2.76	46	52.26	157	172	167	176	119.50
6	3.26	71	49.61	166	186	182	188	118.29
7	2.94	35	41.88	186	204	198	209	120.08
8	2.89	40	48.42	204	223	211	226	119.49
9	2.85	42	52.08	217	233	221	235	119.37
10	2.75	41	41.73	231	241	230	244	119.12
11	2.86	42	45.72	241	247	236	247	120.13
12	2.74	43	52.90	248	255	241	253	121.47
13	2.90	45	51.28	251	261	246	258	121.16
14	3.01	47	48.91	249	264	248	260	120.23
15	2.94	44	35.31	251	271	253	263	121.27

STOP #	DRIVER VEHICLE SNUB COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)			
1	-	NOX	NORTH	YES
2	-	NOX	EAST	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES
5	-	NOX	SOUTH	YES
6	-	NOX	WEST	YES
7	-	NOX	NORTH	YES
8	-	NOX	NORTH	YES
9	-	NOX	NORTH	YES
10	-	NOX	NORTH	YES
11	-	NOX	EAST	YES
12	-	NOX	EAST	YES
13	-	NOX	SOUTH	YES
14	-	NOX	SOUTH	YES
15	-	NOX	SOUTH	YES

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHT8A NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 05/03/05

DATA SHEET 27 - HOT PERFORMANCE AT GVWR

Testing Conditions: INV DATA, Section 0095, 05/03/05, 11:11:38

Schedule:
Make 2 stops from 100 kph
Pedal Force: 1st stop is done with an average force less than the average recorded in the shortest GVWR Cold Effectiveness stop.
2nd stop is done with a force less than 500 N.
No Lock-Up allowed longer than 0.1 sec above 15 km/h.
Distance Requirements are based on the following:
shortest stop in Data Sheet 11 is: 6
Initial speed of stop: 99.99 (kph)
Actual distance of stop: 47.3 (meter)
Average pedal force: 364.7 (N)

Performance Requirements:
Stop Number 1 must be less than: 72.2 (meter)
In addition the stopping distance for at least one of the of the two hot stops must be less than: 89 (meter)

STOP #	INIT SPD (kph)	LEFT PRONT IBT (°C)	RIGHT PRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	98.99	258	282	260	271	45.8	46.7	376.59	271.00	11.50	7.52
2	100.11	264	289	278	284	46.9	46.8	464.00	358.78	13.20	7.61

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)			
1	-	NOX	WEST	YES
2	-	NOX	WEST	YES

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 05/03/05

DATA SHEET 28 - BRAKE COOLING STOPS AT GVWR

Testing Conditions: INV DATA, Section 0100, 05/03/05, 11:14:41

Schedule:
Initial Brake Temperature:
Achieved on completing Hot Performance
Initial Speed 50 km/h to zero
4 stops with transmission in gear

Performance Requirements:
Constant Decel rate: 3.0 m/s/s
Pedal force adjusted as necessary
No Lock-Up allowed longer than 0.1 sec above 15 km/h
Vehicle Must stay in lane of 3.5m

STOP #	INIT SPD (kph)	AVG. DECEL (m/sec²)	AVG. PEDAL PORCE (N)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)
1	48.93	3.17	41.39	218	243	222	222
2	50.28	2.85	38.75	173	187	160	171
3	50.74	2.65	47.91	148	147	123	141
4	50.25	2.64	53.48	125	121	102	122

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock up - Direction of Stop - Stay in Lane)			
1	-	NOX	NORTH	YES
2	-	NOX	NORTH	YES
3	-	NOX	NORTH	YES
4	-	NOX	EAST	YES

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO GOTHENBUR NHTSA NUMBER: C55900
Make: VOLVO
Model: S40 2.4I M
Body Style: 4-DOOR SEDAN
Front Cold Tire Pressure: 248 (Kpa)
Rear Cold Tire Pressure: 248 (Kpa)

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Date Tested: 05/03/05

DATA SHEET 29 - RECOVERY PERFORMANCE AT GVWR

Testing Conditions: INV DATA, Section 0105, 05/03/05, 11:22:00

Weather Conditions: 42°F Wind: 16 mph 223° Start Odo.: 483 End Odo.: 500

Schedule:
Make 2 stops from 100 kph
Pedal Force: Both stops are performed with an average force less than the average recorded in the shortest GVWR Cold Effectiveness stop.

Performance Requirements:
One of the two stops must be within the following limits:
Upper limit of corrected stopping distance: 63.3 (meter)
Lower limit of corrected stopping distance: 34.9 (meter)

No Lock-Up allowed longer than 0.1 sec above 15 km/h.
Distance Requirements are based on the following:
Shortest stop Data Sheet 11 is:Stop 6
Initial speed of stop: 99.99 (kph)
Actual distance of stop: 47.3 (meter)
Average pedal force: 364.7 (N)

STOP #	INIT SPD (kph)	LEFT FRONT IBT (°C)	RIGHT FRONT IBT (°C)	LEFT REAR IBT (°C)	RIGHT REAR IBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	99.62	114	111	97	113	47.4	47.8	378.78	263.88	13.62	7.49
2	99.69	132	132	126	138	46.1	46.4	366.21	272.86	12.54	7.64

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)		
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: KAREN EASTERDAY Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

DATA SHEET 30 (Part 1 of 5)
6.0 Test Completion Inspection (7.17)

VEHICLE: 2005 Volvo S40 2.4l M NHTSA NO.: C55900 DATE: 05/10/05

System Integrity (S5.6)

Each vehicle shall meet the complete performance requirements of this standard without:
(a) Detachment or fracture of any component of the braking system such as brake springs and brake shoes or disc pad facings, other than minor cracks, that do not impair attachment of the friction facings. All mechanical components of the braking system shall be intact and functional. Friction facing tearout (complete detachment of lining) shall not exceed 10 percent of the lining on any single frictional element.
(b) Any visible brake fluid or lubricant on the friction surface of the brake or leakage at the master cylinder or brake power unit reservoir cover, seal, and filler openings.

Friction Material Condition: Primary/Inner		**Friction Material Condition: Secondary/Outer**	
LF	Normal Appearance & Color	LF	Normal Appearance & Color
RF	Normal Appearance & Color	RR	Normal Appearance & Color
LR	Normal Appearance & Color	LF	Normal Appearance & Color
RR	Normal Appearance & Color	RR	Normal Appearance & Color
Drum (or Rotor) Condition:		**Brake Fluid/Lubricant Inside Brakes:**	
LF	Normal Appearance & Color	LF	Minor weeping – piston seal.
RF	Normal Appearance & Color	RF	None
LR	Normal Appearance & Color	LR	None
RR	Normal Appearance & Color	RR	None
Hydraulic Component Condition:		**Mechanical Component Condition:**	
LF	Good	Brk/Pedal	Good
RF	Good	Power Brk	Good
LR	Good	Stop/Lamp	Good
RR	Good	Linkage	Good
M/Cyl	Good	Other	NA

COMPLIANCE: Yes X No____
Comments: None.

Technician: K. Easterday

DATA SHEET 30 (Part 2 of 5)
TEST COMPLETION INSPECTION (S7.17)

VEHICLE: 2005 Volvo S40 2.4I M; NHTSA NO.: C55900; GVWR: 1960 kg
MASTER CYLINDER RESERVOIR:

DATE	05/06/05	Requirements	Pass	Fail
Reservoir Compartments (S5.4.1)				
(1) Does master cylinder have a reservoir compartment for each brake subsystem?	***Yes***	Master cylinder shall have a reservoir compartment for each subsystem.	X	
	No			
(2) Does loss of fluid in one compartment result in complete loss from another compartment?	Yes	Loss of fluid from one compartment shall not cause complete loss from another compartment.	X	
	No			
Reservoir Capacity (S5.4.2)				
Shall conform to requirements (1) or (2), state units:				
(1) For reservoirs having completely separate compartments for each subsystem (two separate, independent reservoirs):				
Subsystem 1 Subsystem reservoir capacity		Each compartment (reservoir) shall have a minimum capacity equivalent to the fluid displacement resulting when all wheel cylinders or caliper pistons serviced by that independent compartment/reservoir moves from a new lining, fully retracted position to a fully worn, properly adjusted, fully applied position. **(Use Data Sheet 31 and Appendix 1A)**	NA	NA
Subsystem 1 Fluid displaced from new to worn lining				
Subsystem 2 Subsystem reservoir capacity			NA	NA
Subsystem 2 Fluid displaced from new to worn lining				
2) For reservoirs utilizing a portion of the reservoir for a common supply to two or more subsystems:				
Total minimum capacity for the entire master cylinder reservoir (includes individual compartment reservoirs)	343 ml	Shall have total minimum capacity for entire reservoir for displacement resulting from all subsystem wheel cylinders or caliper positions moving from new lining to full worn condition as above.	X	
Fluid displaced from new to worn linings (ALL linings) *Value calculated from Data Sheet 31	142.5 ml*			

Comments: None

DATA SHEET 30 (Part 3 of 5)
TEST COMPLETION INSPECTION (S7.18)

VEHICLE: 2005 Volvo S40 2.4l M; NHTSA NO.: C55900; GVWR: 1960 kg

MASTER CYLINDER RESERVOIR:

DATE	05/06/05	Requirements	Pass	Fail
Master Cylinder Piston Displacement(S5.4.2) [If Common Reservoir Supply - continued from previous page]				
Fluid displaced by three strokes of master cylinder piston for Primary (Subsystem No. 1)	24 ml	Individual partial compartments of reservoir shall **each** have a minimum of fluid equal to at least the volume displaced by the master cylinder piston servicing the subsystem during a full stroke of the piston. **NOTE:** Procedure uses three strokes to ensure an accurate measurement. ✓ close per Andy — did multiple times. is close but OK, [initials]		
Fluid displaced by three strokes of master cylinder piston for Secondary (Subsystem No. 2)	24 ml			
Fluid displaced per stroke, Primary	8 ml			
Fluid displaced per stroke, Secondary	8 ml			
Fluid available in partial compartment Subsystem No. 1	11 ml		X	
Fluid available in partial compartment Subsystem No. 2	80 ml		X	
Brake Power Unit Reservoir (S5.4.2)				
Volume displaced in charging system piston or accumulator to normal operating pressure plus wheel cylinder or caliper piston displacement.		Shall have a capacity at least equal to fluid displacement required to charge the system pistons on accumulators to normal operating pressure plus displacement when wheel cylinders or caliper pistons move from new lining to full worn condition as above.	NA	
Reservoir Labeling (S5.4.3)				
Exact copy of reservoir label: On master cylinder reservoir cap: WARNING. CLEAN FILLER CAP BEFORE REMOVING. USE ONLY DOT 4 BRAKE FLUID FROM A SEALED CONTAINER.		Label shall read: "Warning, clean filler cap before removing; use only * fluid from a sealed container". * Fluid type specified in 49 CFR 571.116	X	
Measure letter height	3.2 mm	Letters shall be at least 3.2 mm/ 0.125" high	X	
Describe label attachment method and location. Embossed on the top of the master cylinder reservoir filler cap.		Lettering shall be permanently affixed, engraved or embossed and located so as to be visible by direct view either on or within 100 mm/3.94 inches of the brake fluid reservoir filler plug or cap.	X	
Does the lettering contrast with the background?	***Yes*** No	If label is not engraved or embossed, letters shall be of a color that contrasts with the background	X	

Comments: None

Technician: K. Easterday

DATA SHEET 30 (Part 4 of 5)
TEST COMPLETION INSPECTION (S7.18)

VEHICLE: 2005 Volvo S40 2.4I M; NHTSA NO.: C55900; DATE: 04/29/05

BRAKE SYSTEM WARNING INDICATOR (S5.5)

CONDITION	ANSWER	REQUIREMENTS	PASS	FAIL
Brake Systems Indicator Lamp Function Check (S5.5.2) (Bulb and systems check)				
Describe location of brake indicator lamp: In lower right quadrant of instrument cluster.	Yes	Shall be in front, and in clear view, of driver.	X	
Does lamp light with ignition (start) switch at ON/RUN?	Yes	Automatic activation when ignition switch is "on" when engine **not running**, or ignition between "on" and "start" if is manufacturer check position- OR -single manual action by driver	X	
Does lamp light with ignition between ON and Start?	Yes			
Brake check description in owner's manual?	Yes	Manufacturer shall explain the brake check function test procedure in the owner's manual.	X	
Brake System Warning Indicator ACTIVATION (S5.5.1) DURATION (S5.5.3) FUNCTION (S5.5.4)				
CONDITION	**Light ON?**	**REQUIREMENT**	**PASS**	**FAIL**
A. In event of hydraulic leak (1) On or before appearance of pressure differential of 218 psi (split system)	NA	When ignition (Start) switch is **ON**, lamp must light whenever (A), (B), (C), or (D) occurs. In addition, if service brake system is not a split system, audible warning must be activated when any condition in (A) exists. Visual warning indicator for non-split systems must be flashing.	X	
(2) If any reservoir falls below either "safe" level or 25% of capacity, whichever is greater.	Yes			
(3) On or before supply pressure to brake power unit falls to 50%	N/A			
B. Electrical functional failure in an antilock or variable brake proportioning system.	Yes		X	
C. Application of the parking brake.	Yes			
D. Brake lining wear-out if optical warning	NA			
Must have Audible alarm if not split system and a condition in (a) above exists?	NA			
If condition (A) (2) above does not exist, then fluid reservoir must be **transparent** for fluid check without the need for reservoir to be opened? (S5.4.4)	NA			
Indicator lamps remain activated as long as condition exists - ignition "on", and engine on or off? _____ (S5.5.3 DURATION))	Yes			
Visual warning – continuous or flashing?	Yes-Cont.			
Audible warning –continuous or flashing?	N/A			

Comments: The vehicle possesses an additional information display that states the type of failure – located in the upper-center of the instrument cluster.

Technician: K. Easterday

DATA SHEET 30 (Part 5 of 5)
TEST COMPLETION INSPECTION (S7.18)

VEHICLE: 2005 Volvo S40 2.4I M; NHTSA NO.: C55900; DATE: 04/29/05

BRAKE SYSTEM WARNING INDICATOR LABELING (S5.5.5)

CONDITION AND REQUIREMENT	ANSWER NOTE: Standard requires that the answer to questions be YES	PASS	FAIL
Are visual indicators legible to driver in daylight and nighttime conditions when activated?	Yes	X	
Are visual indicator words 3.2 mm (.125") high minimum? Record Height: "Brake" - 3.2 mm; "ABS" – 3.2 mm.	Yes	X	
Visual indicator words and background contrasting colors, one of which is red. Record colors Letters –Red, Lens – Black	Yes	X	
If split system, is there one brake indicator? If yes, does it say the word "Brake"? Word: "BRAKE".	Yes	X	
If not split system; is there a separate indicator for loss of fluid or fluid pressure? Does this indicator say "Stop-Brake Failure"? Are the letters block and not less than 6.4 mm (.25") in height? Record letter height_____	NA		
If separate indicator for: 1. Low brake fluid per S5.5.1(a)(1), does indicator say "Brake Fluid"? NOTE: not required for mineral oil system Record wording_____ 2. Gross pressure loss per S5.5.1(a)(2), does indicator say "Brake Pressure"? Record wording _____ 3. Electrical functional failure in antilock or variable proportioning system per S5.5.1(b), letters and background contrasting colors one of which is yellow? Record colors Lens – Black, Letters – Amber or yellow Does indicator say "Antilock" or "ABS" or "Brake Proportioning"? Record wording "ABS". 4. Parking brake per S5.5.1(c), does indicator say "Park" or "Parking Brake"? Record wording "PARK BRAKE" 5. Brake lining wear-out per S5.5.1(d), does indicator say "Brake Wear"? Record wording NA 6. For any other function? If yes, Record NA	NA NA Yes Yes Yes NA NA	X	

Comments: The vehicle possesses an additional information display that states the type of failure – located in the upper-center of the instrument cluster.

Technician: K. Easterday

DATA SHEET 31 (Part 1 of 2)
CALCULATION OF MINIMUM RESERVOIR VOLUME REQUIREMENTS

VEHICLE: 2005 Volvo S40 2.4l M; NHTSA NO.: C55900; DATE: 05/03/05

BRAKE		LINING		
LOCATION	TYPE	DESCRIPTION	MINIMUM THICKNESS	THICKNESS TO FULLY WORN (1) mm*
Left Front	Drum	Leading	Pre-test 11.63 mm	2 mm
		Primary	Post Test 10.82 mm	
		Inboard X	Δ 0.81 mm	
	Disc X	Trailing	Pre-test 11.53 mm	2 mm
		Secondary	Post Test 10.54 mm	
		Outboard X	Δ 0.99 mm	
LINING CLEARANCE:	Diametrical (2): N/A	Inboard – 0.1 mm.	Outboard – 0.1 mm.	
WHEEL CYLINDER DIAMETER (3) N/A		CALIPER PISTON DIAMETER (3): 56.92 mm (x1 piston).		
SHOE CAGE DIAMETER (4) N/A ; CENTER POINT OF BRAKE ASSY TO CENTER POINT OF W.C. N/A				
Right Rear	Drum	Leading	Pre-test 10.77 mm	2 mm
		Primary	Post Test 9.75 mm	
		Inboard X	Δ 1.02mm	
	Disc X	Trailing	Pre-test 10.39 mm	2 mm
		Secondary	Post Test 9.96 mm	
		Outboard X	Δ 0.43 mm	
LINING CLEARANCE:	Diametrical (2) N/A	Inboard – 0.1 mm.	Outboard – 0.1 mm.	
WHEEL CYLINDER DIAMETER (3): N/A		CALIPER PISTON DIAMETER (3): 37.92 mm (x1 piston).		
SHOE CAGE DIAMETER (4): N/A		CENTER POINT OF BRAKE ASSY TO CENTER PT. OF W.C.: N/A		
CIRCUIT #1 CONSISTS OF:	LF – X	LR	RF	RR – X
CIRCUIT #2 CONSISTS OF:	LF	LR – X	RF – X	RR

(1) MFRS. RECOMMENDATIONS – 2.0 mm, Front and Rear.
(2) REAR - TOP OF RIVET HEADS – N/A.
FRONT - 1/32 INCH – N/A. MFRS. DATA – 0.1 mm, Front and Rear.

(2) DRUM BRAKES, MEASURED AT HORIZONTAL CENTERLINE: N/A.

(3) MFRS. DATA: Front – 57 mm; Rear – 38 mm.

(4) RESET POSITION: N/A.

Comments: Manufacturer's data/specifications: New: Front Lining Thickness – 12 mm; Rear Lining Thickness – 10.6 mm.

Technician: K. Easterday

DATA SHEET 31 – SECTION CONTINUED (Part 2 of 2)

Vehicle: 2005 Volvo S40 2.4l M; NHTSA No.: C55900; Date: 05/17/05

Procedure and Example for Determining Master Cylinder Volume Requirement

The procedure followed for determining the minimum volume requirements is outlined in the example shown below. The required data is taken from the previous page.

DISC BRAKES

Volume Required, $V_r = (\Delta t_i + t_{ic} + \Delta t_o + t_{oc}) \times [\pi (D^2)]/4$, where –

V_r = Volume required per wheel
Δt = Change in thickness (average)
i = Inboard
o = Outboard
D = Caliper cylinder diameter
c = Average clearance

Using the above equations, the volume requirements for Subsystem No. 1 (LR, RR) and Subsystem No. 2 (RF, LR) were calculated utilizing measured and manufacturer's provided data to create the greatest displacement, as shown below:

Disc Brake: (Front)

$$V_r = (\Delta t_i + t_{ic} + \Delta t_o + t_{oc}) \times \frac{\pi D^2}{4}$$

Δt_i = 10 mm
Δt_o = 10 mm
$t_{ic} + t_{oc}$ = 0.2 mm
D = 57 mm

$$V_r = (10 + 0.1 + 10 + 0.1) \frac{\pi (57)^2}{4}$$

$$= 20.2 (2551.76)$$
$$= 51545.5 \text{ mm}^3 = 51.6 \text{ ml}$$

Disc Brake: (Rear)

$$V_r = (\Delta t_i + t_{ic} + \Delta t_o + t_{oc}) \times \frac{\pi D^2}{4}$$

Δt_i = 8.77 mm
Δt_o = 8.6 mm
$t_{ic} + t_{oc}$ = 0.2 mm
D = 38 mm

$$V_r = (8.77 + 0.1 + 8.6 + 0.1) \frac{\pi (38)^2}{4}$$

$$= 17.37 (1134.11)$$
$$= 19699.58 \text{ mm}^3 = 19.7 \text{ ml}$$

For System 1 (LF, RR)

$V_{r1} = 51546 \text{ mm.}^3 + 19700 \text{ mm.}^3 = 71246 \text{ mm.}^3$

$V_{r1} = 71246 \text{ mm}^3 = (71.2 \text{ ml})$

For System 2 (RF, LR)

$V_{r2} = V_{r1}$

$V_{r2} = 71246 \text{ mm}^3 = (71.2 \text{ ml})$

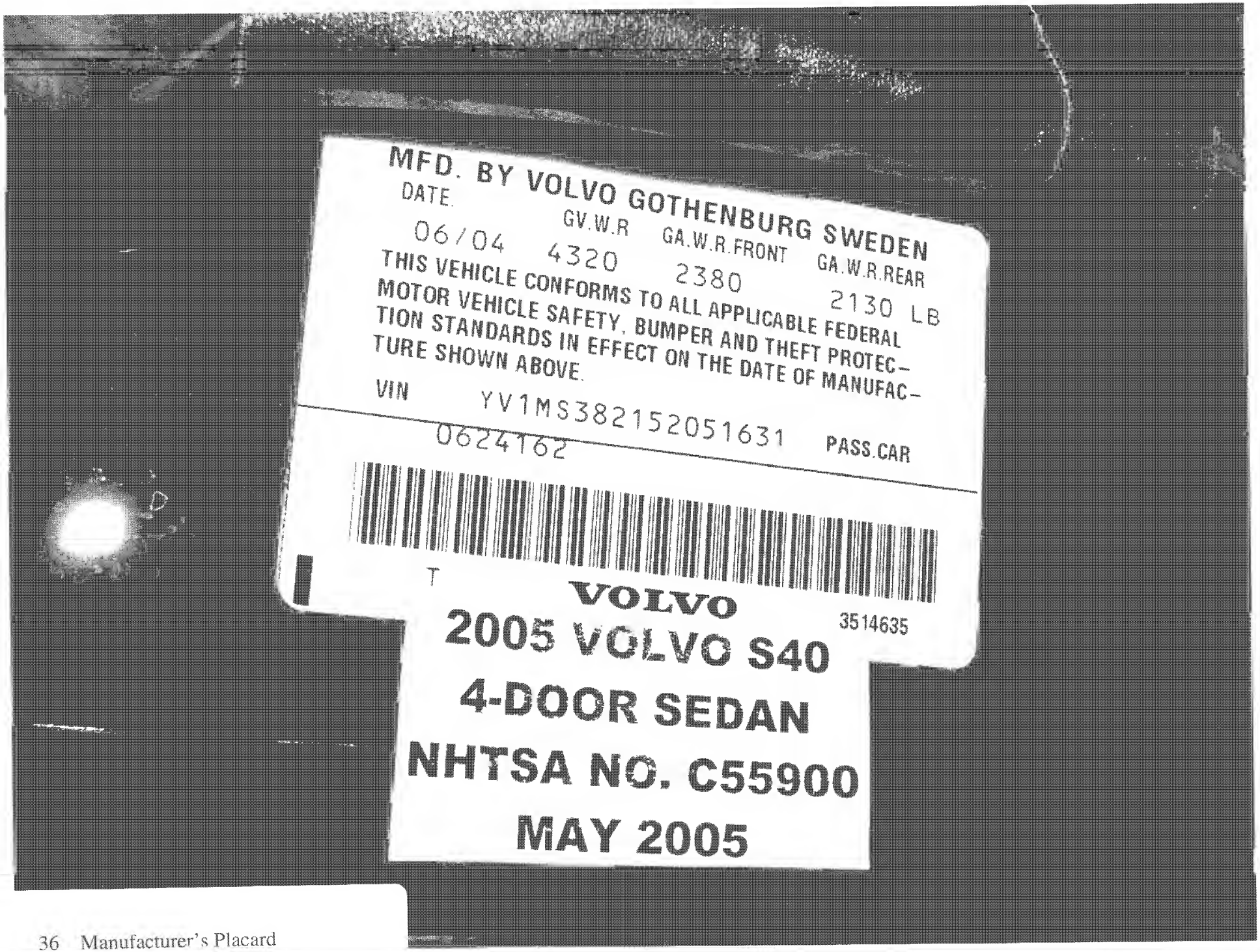
TOTAL VOLUME REQUIRED = $V_t = V_{r1} + V_{r2} = 142492 \text{ mm}^3 = 142.5 \text{ ml}$*

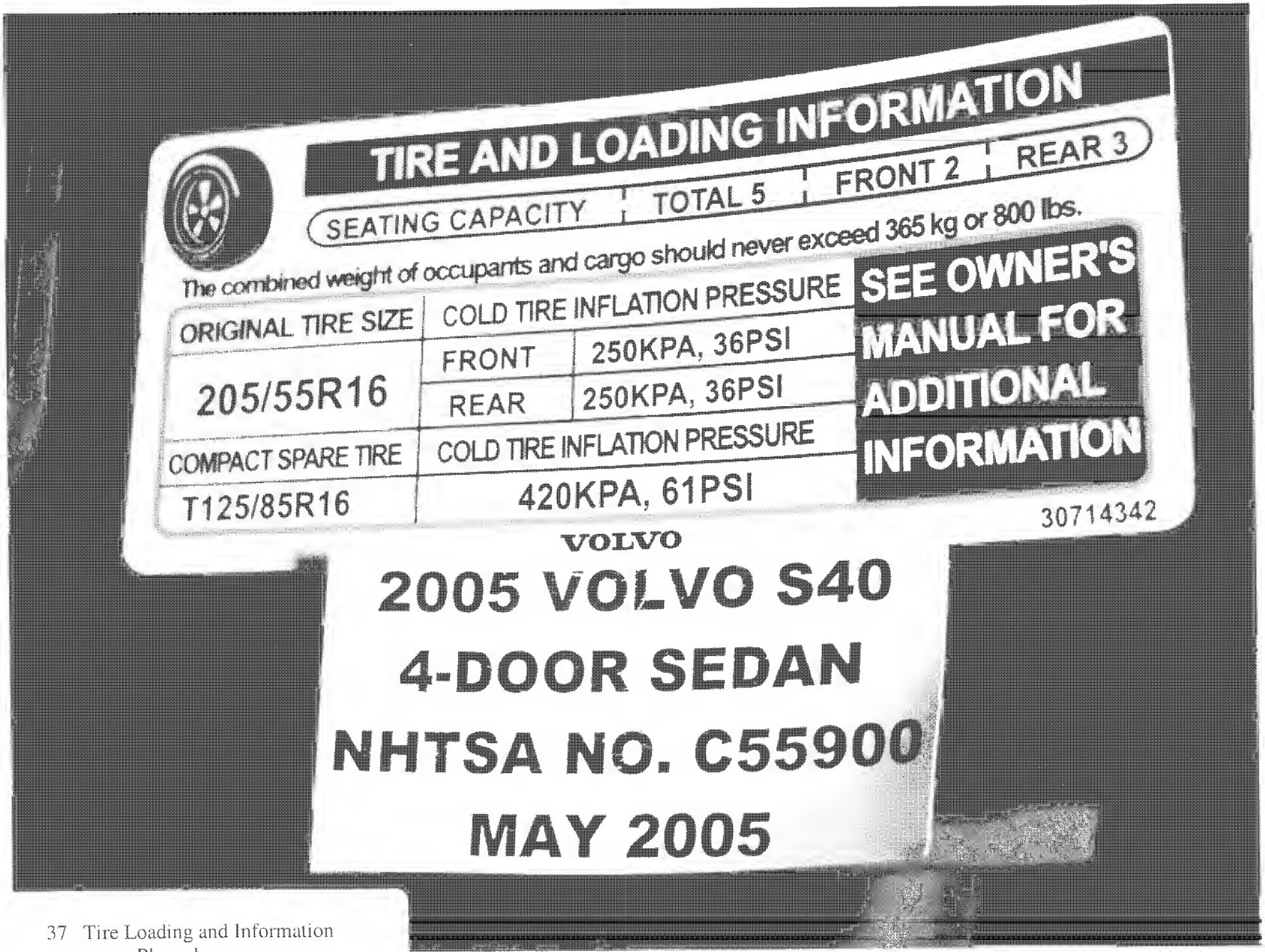
Section 6.0

Photographs

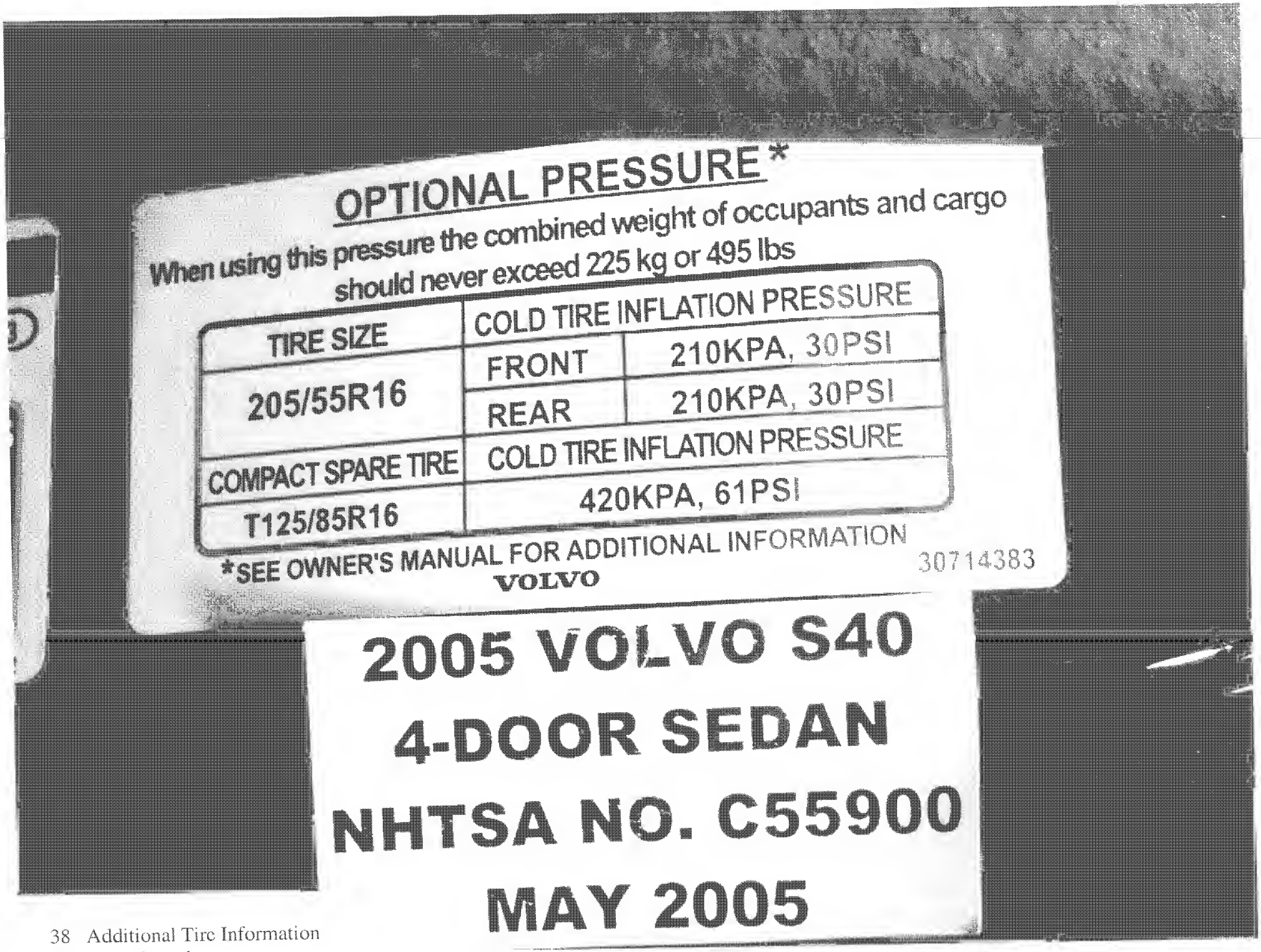

2005
VOLVO S40
4 DR. SEDAN
NHTSA NO.
C55900
MAY 2005

35 3/4 Rear

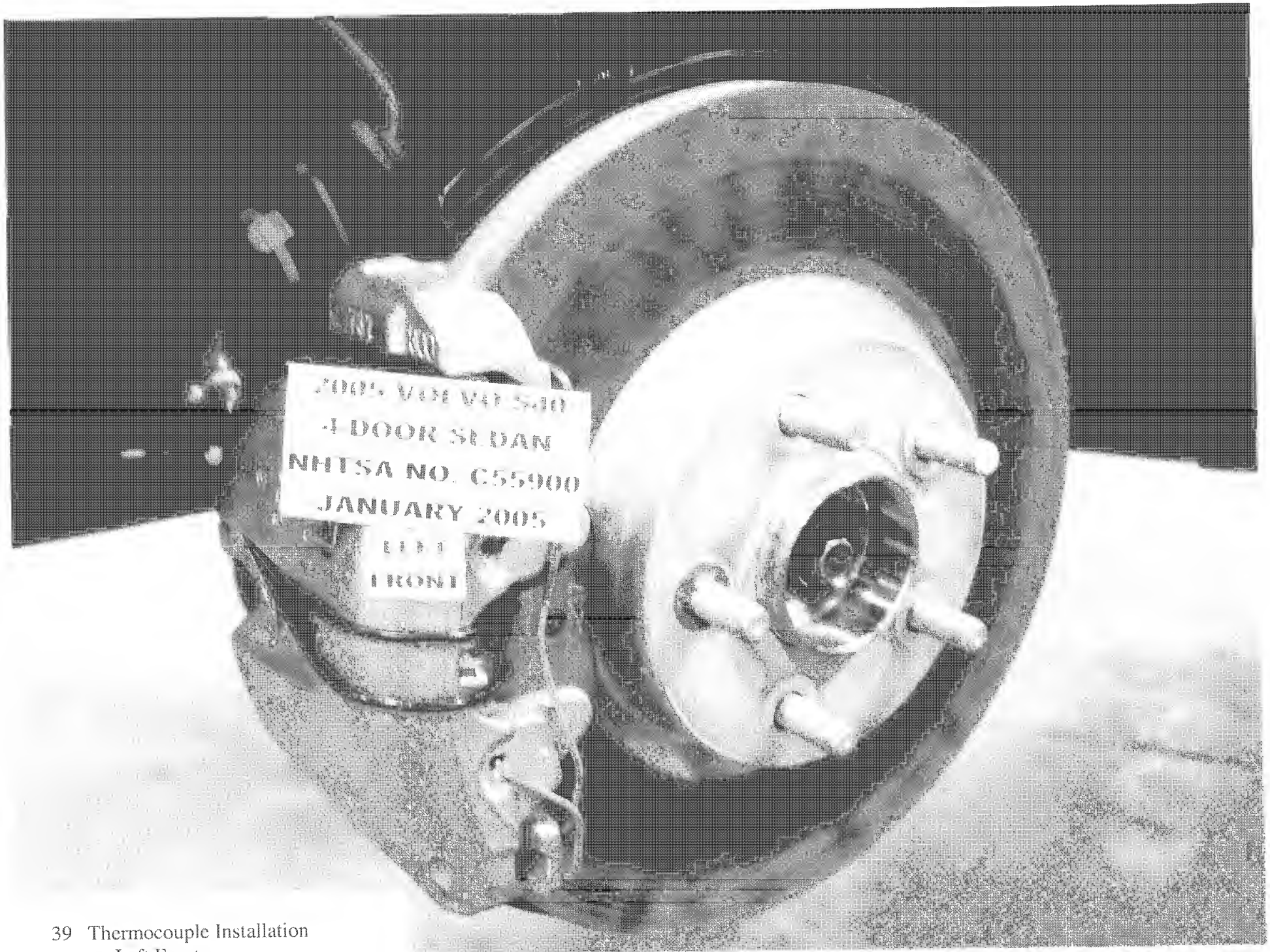

MFD. BY VOLVO GOTHENBURG SWEDEN
DATE
GV.W.R
GA.W.R.FRONT
GA.W.R.REAR
06/04
4320
2380
2130 LB
THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY, BUMPER AND THEFT PROTECTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.
VIN YV1MS382152051631
PASS.CAR
0624162
T
VOLVO
3514635
2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
MAY 2005



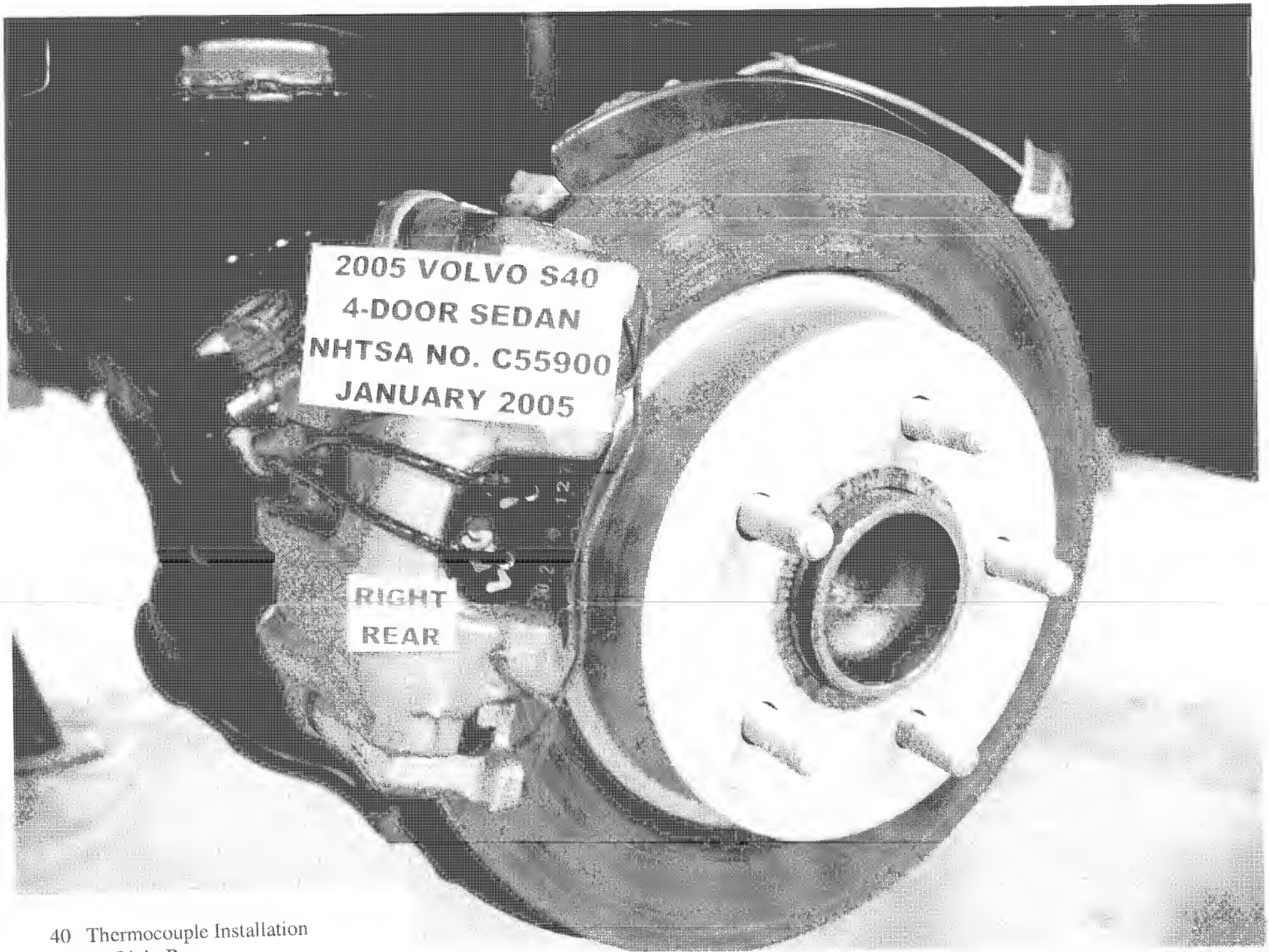
37 Tire Loading and Information Placard



38 Additional Tire Information Placard

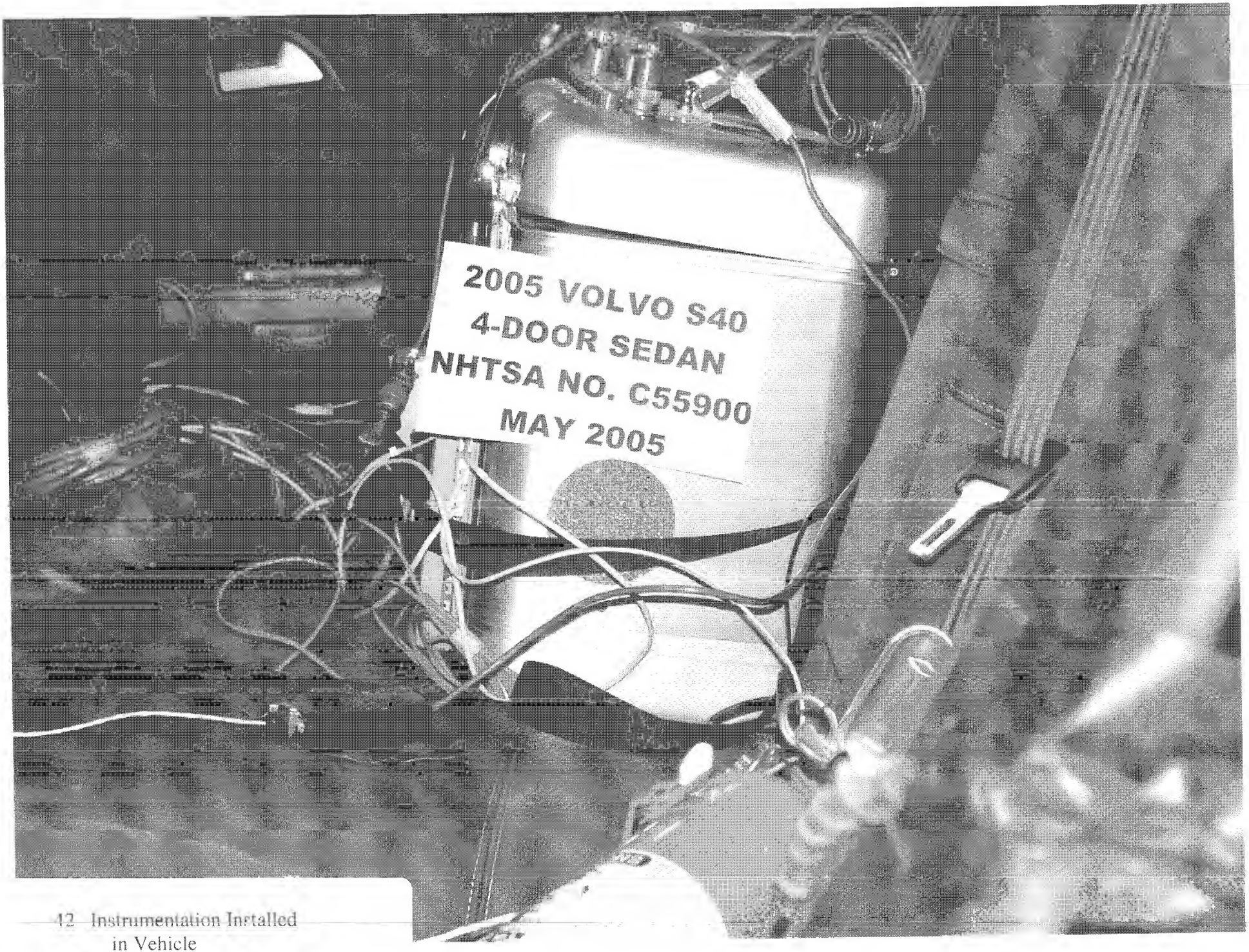


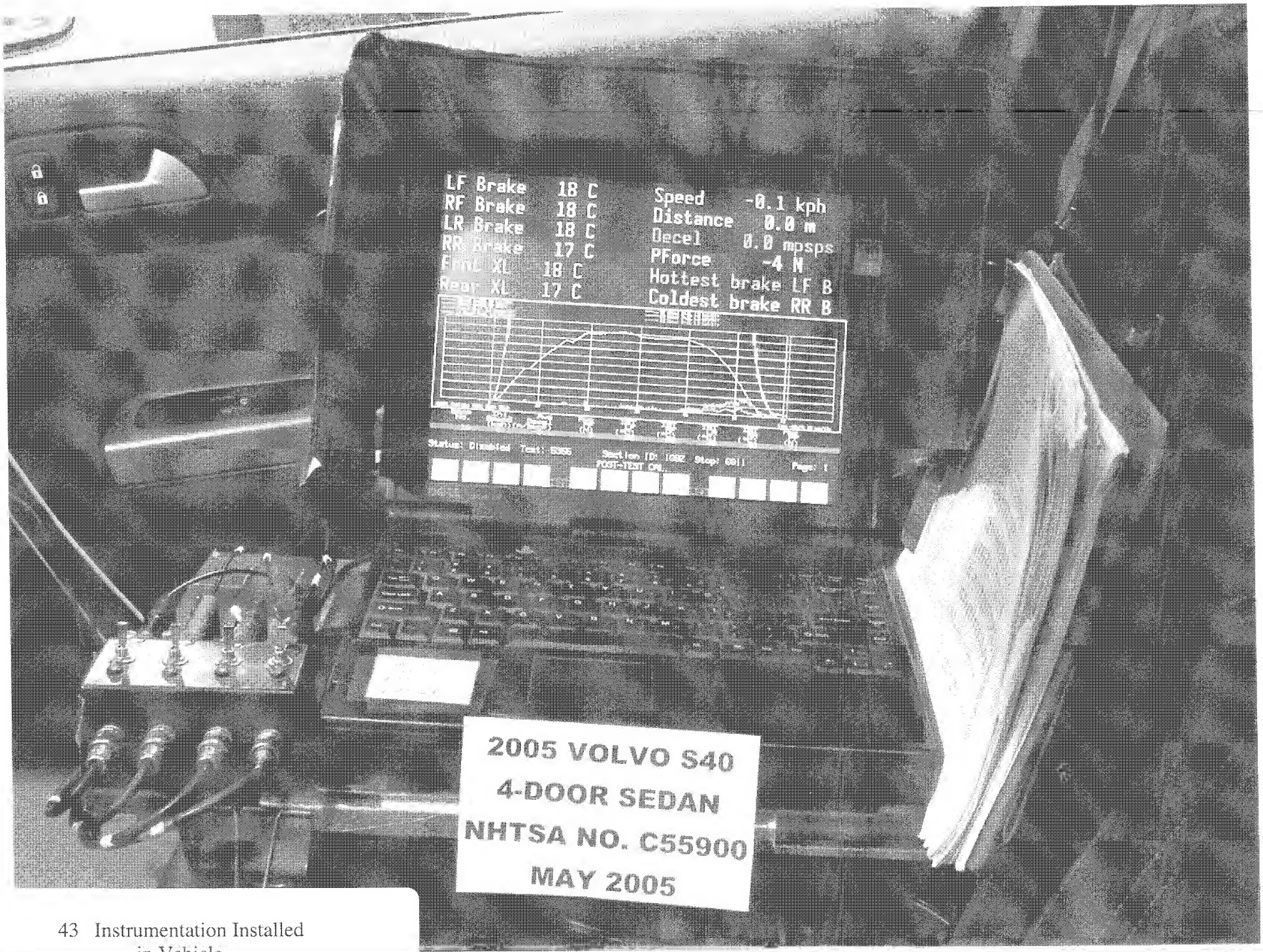
39 Thermocouple Installation
Left Front



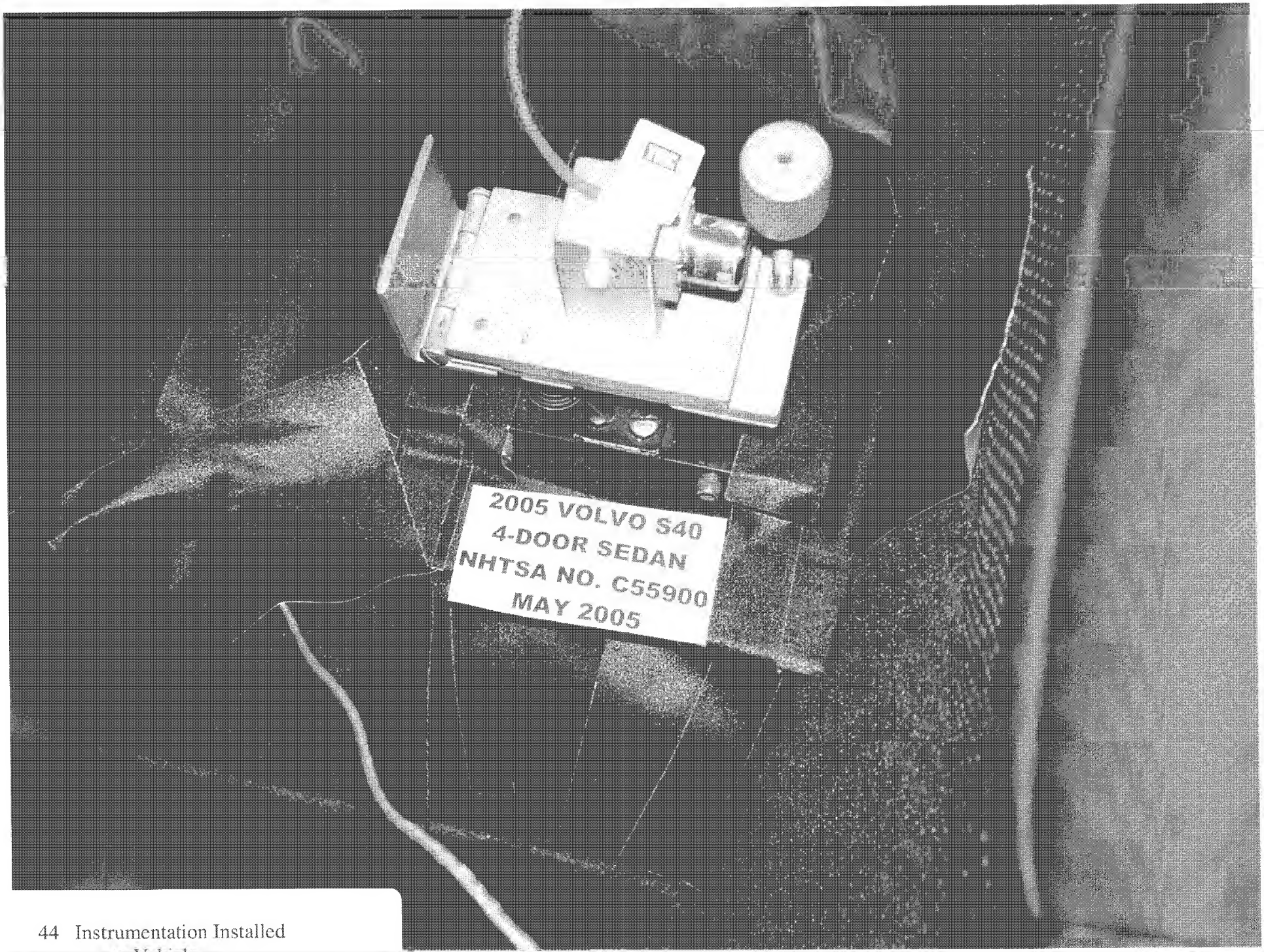
40 Thermocouple Installation
Right Rear

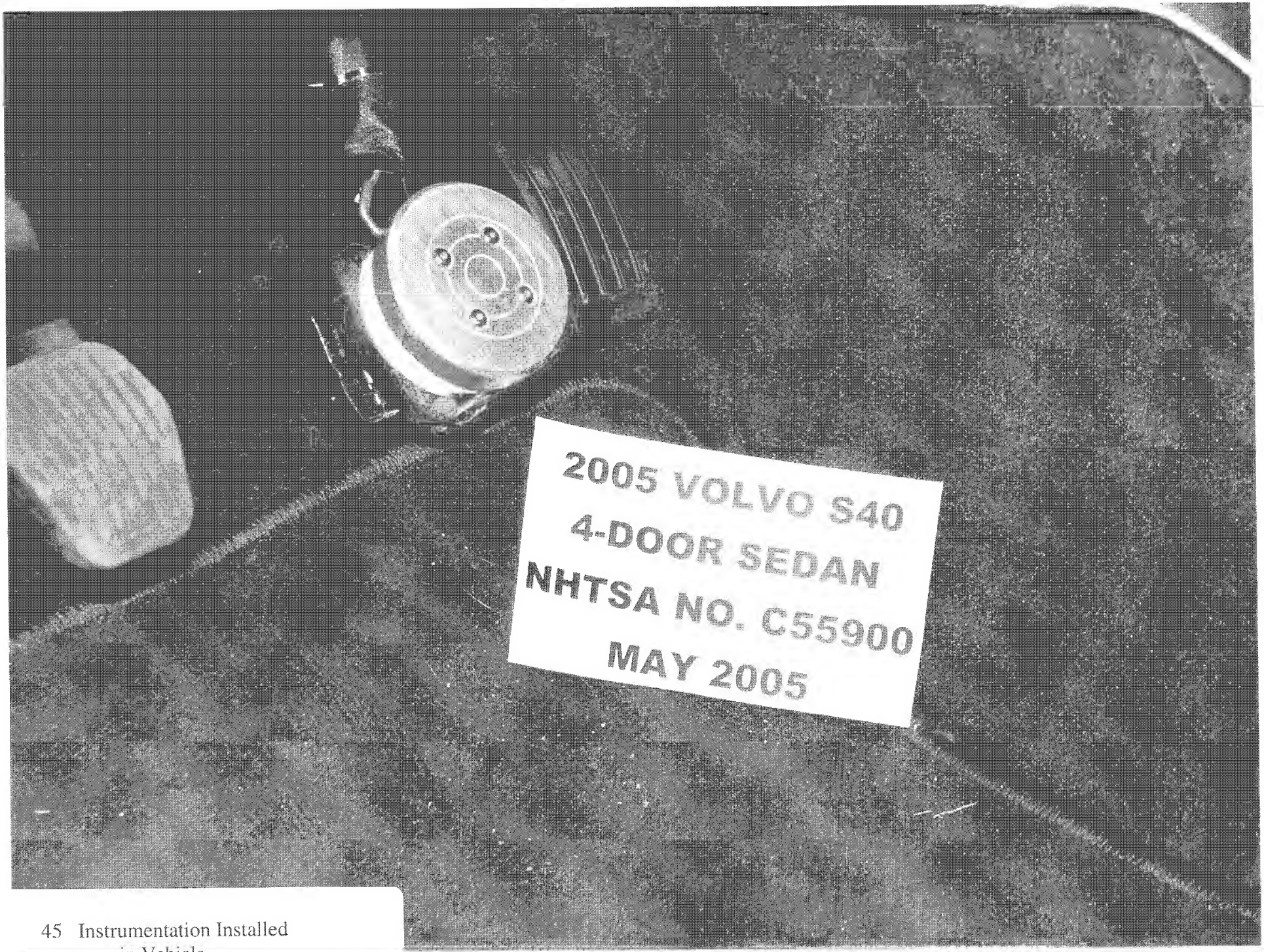
41 Instrumentation Installed in Vehicle


2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
MAY 2005



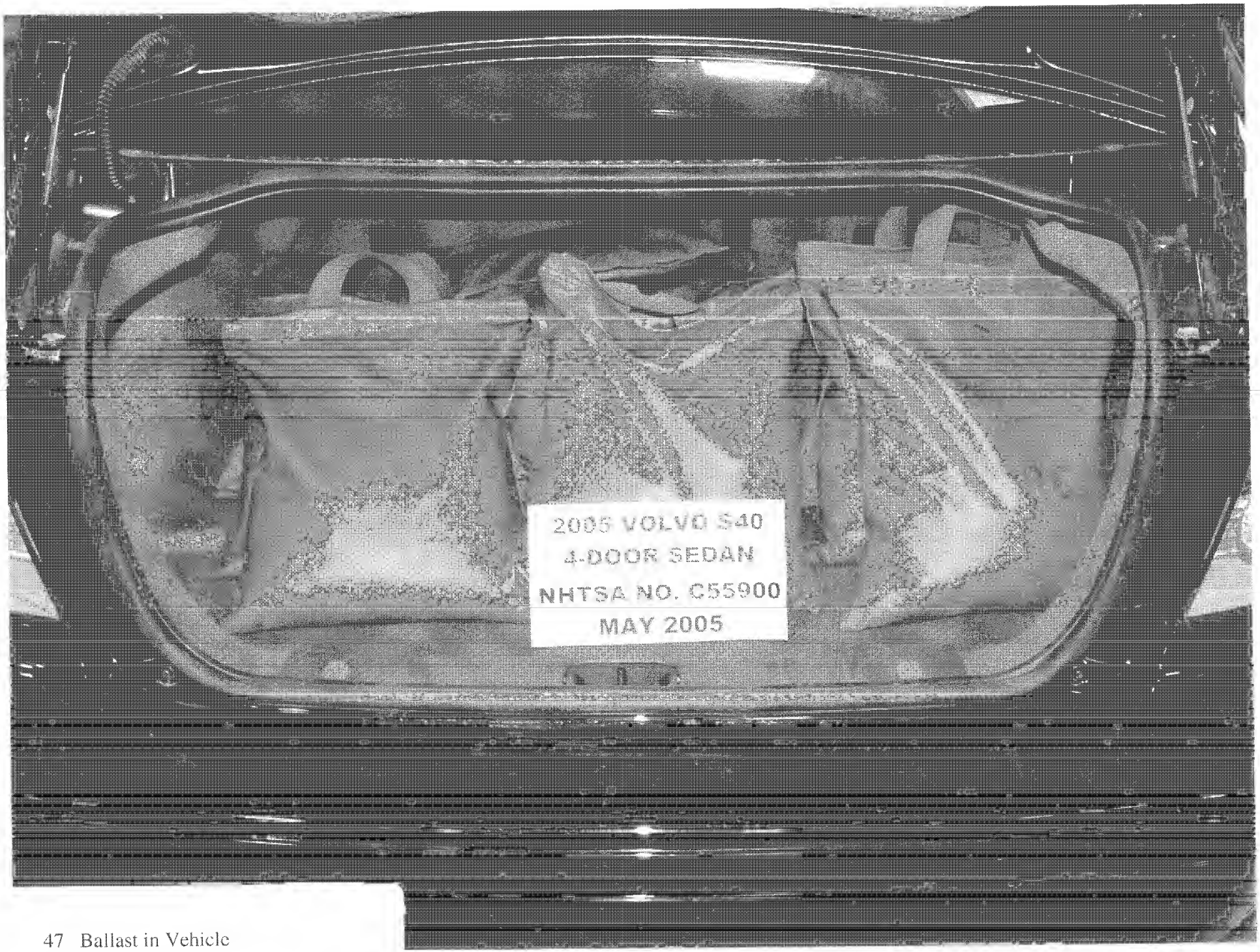
43 Instrumentation Installed in Vehicle


2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
MAY 2005

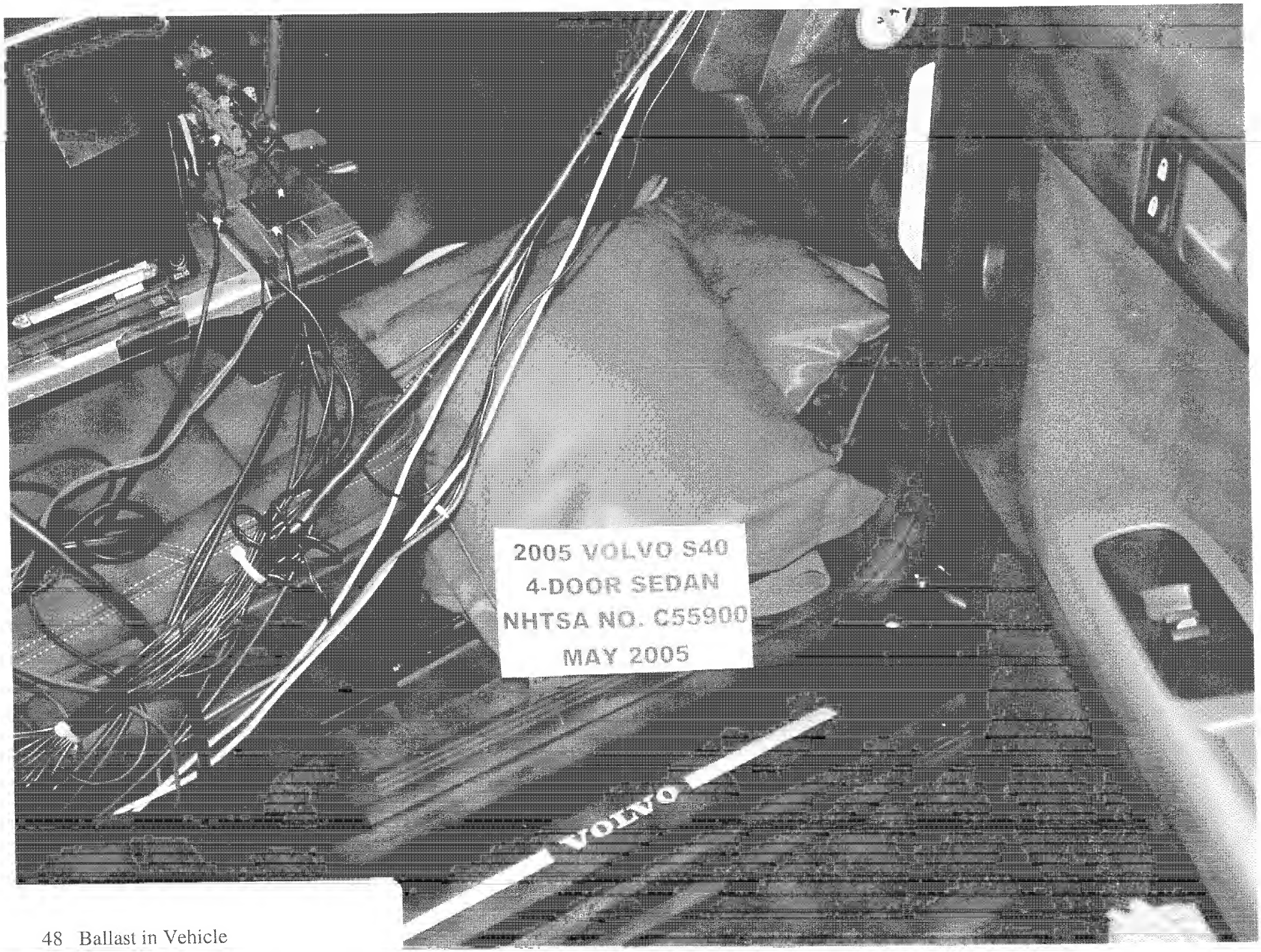


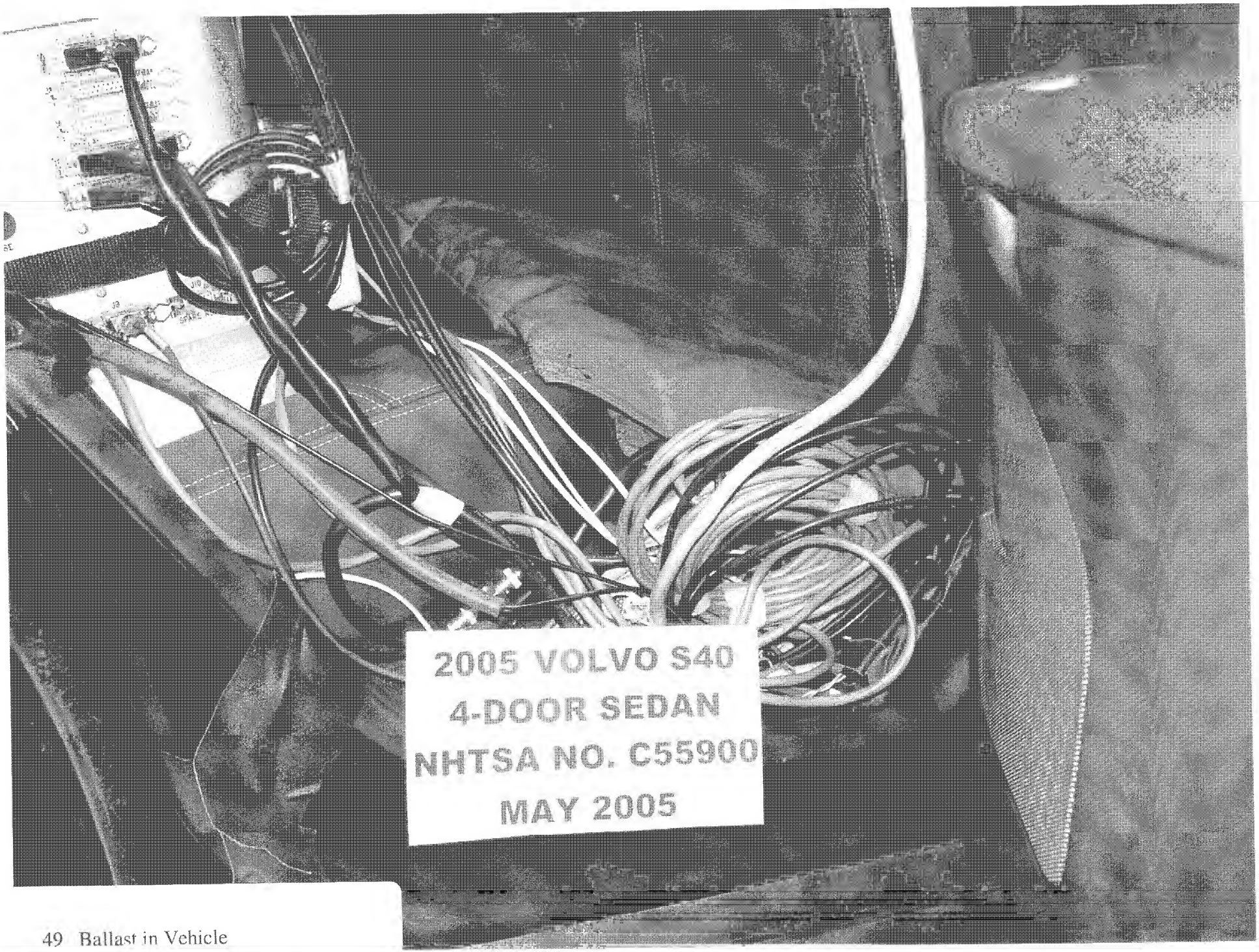
45 Instrumentation Installed in Vehicle

46 Vehicle Being Weighed

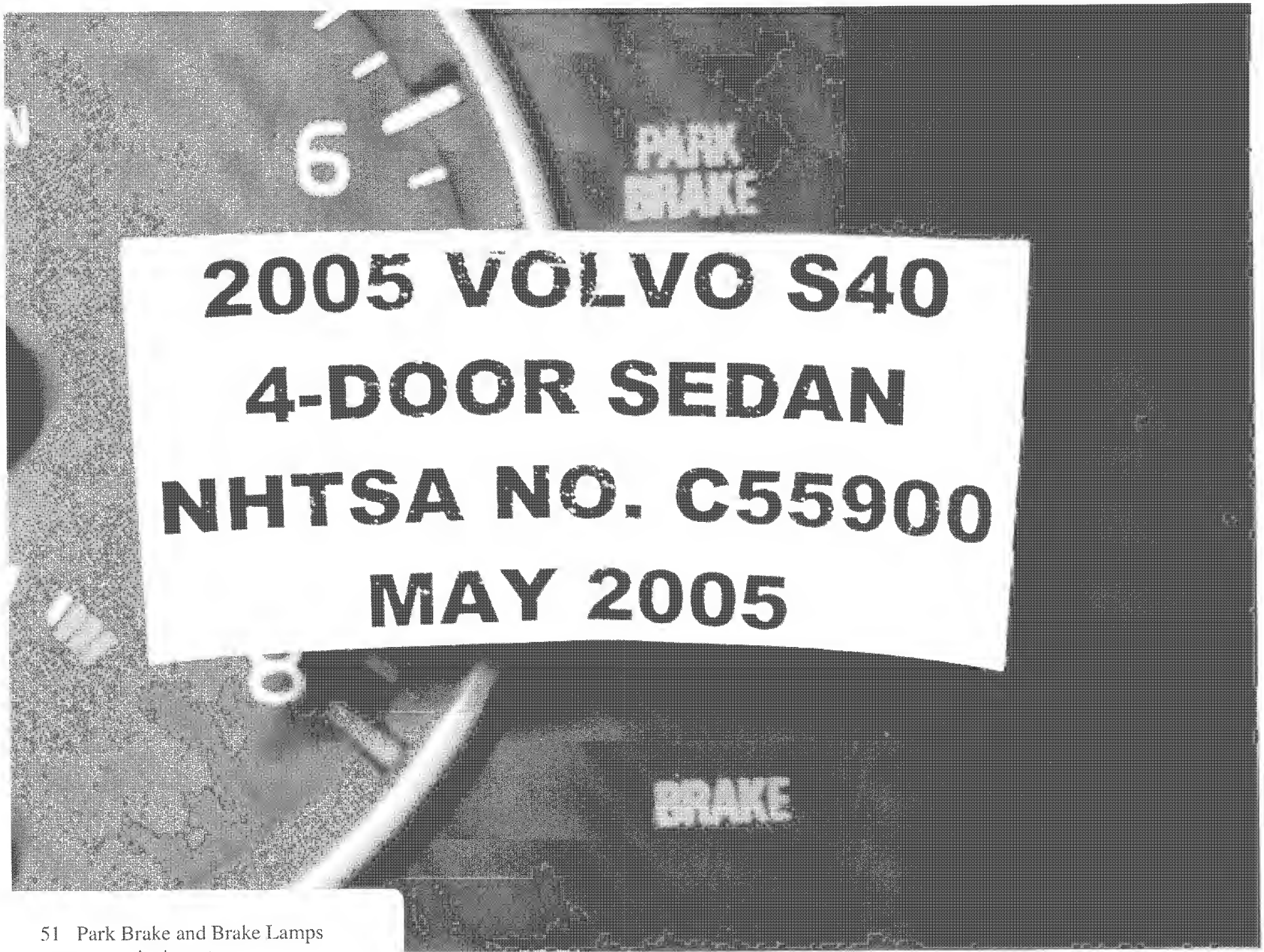


47 Ballast in Vehicle

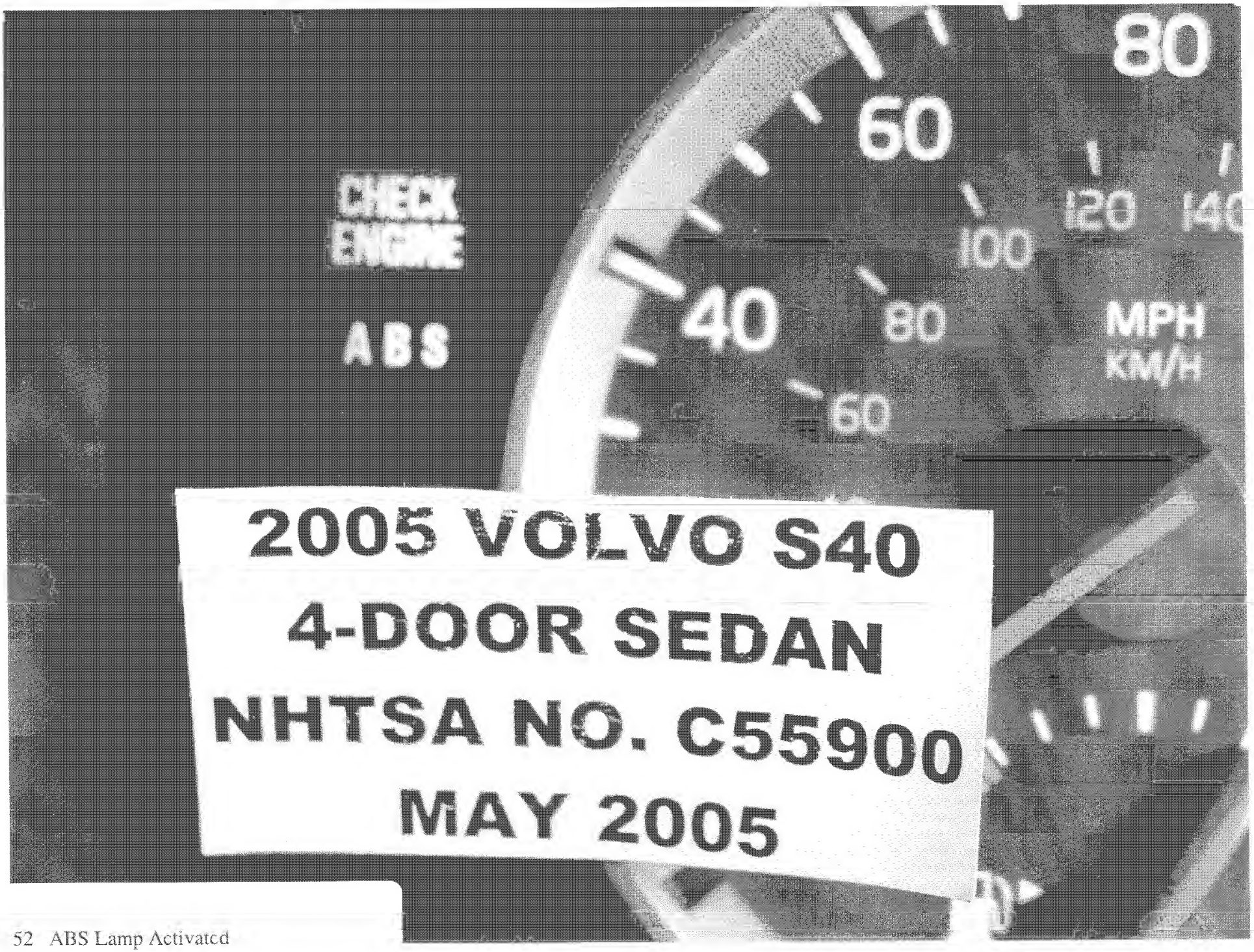

2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
MAY 2005
VOLVO

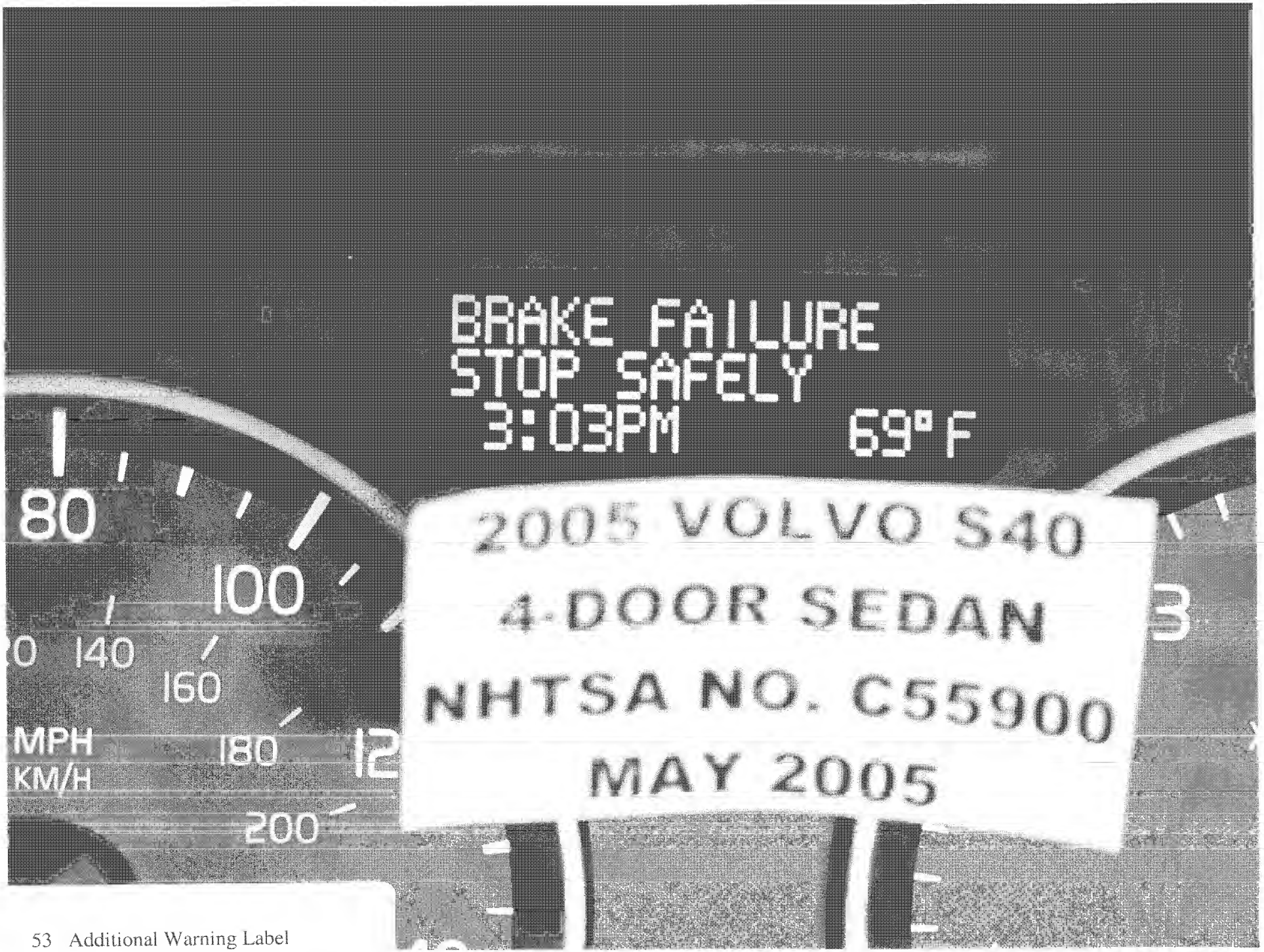

2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
MAY 2005


2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
MAY 2005

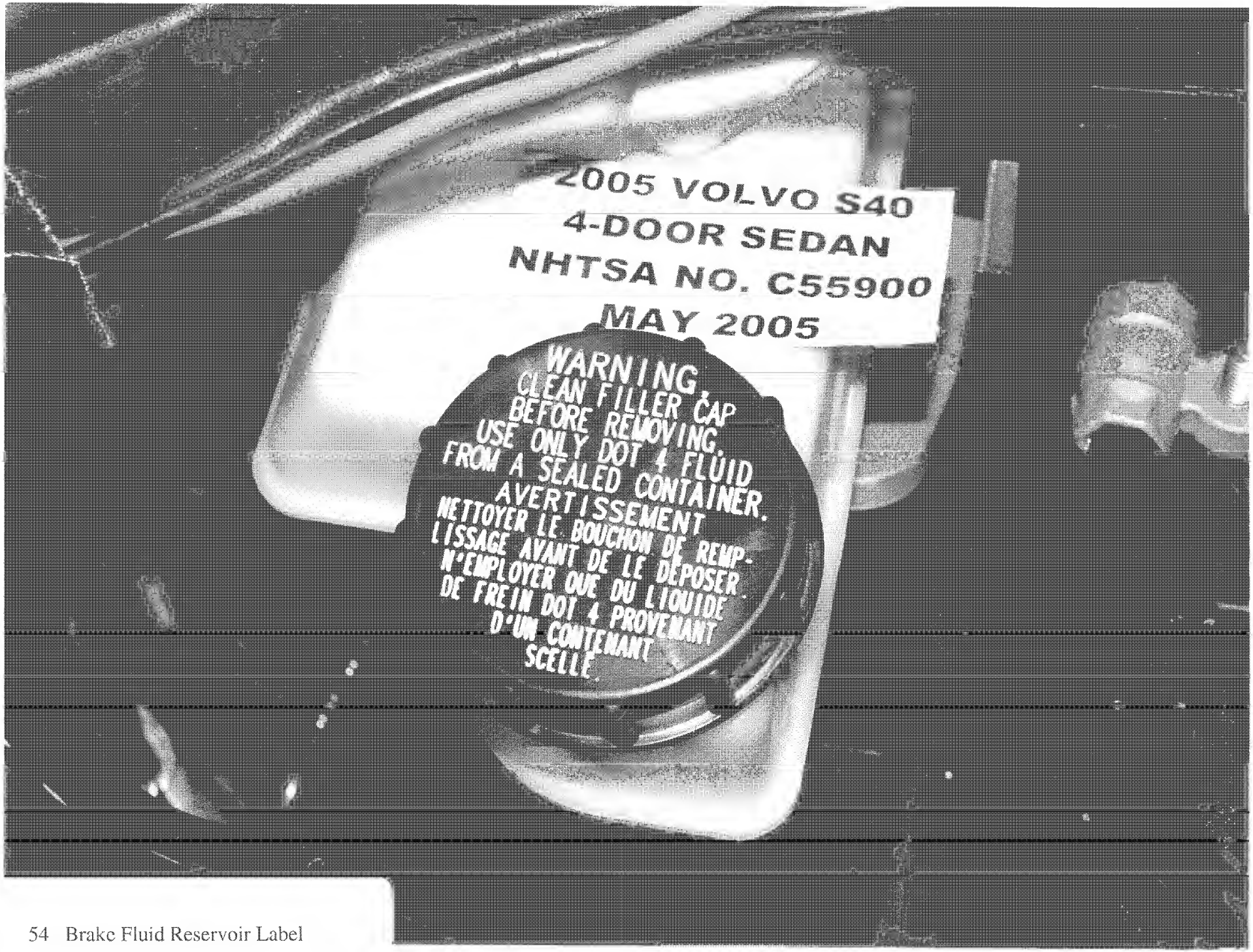


51 Park Brake and Brake Lamps Activated


CHECK ENGINE
ABS
40
60
80
100
120
140
MPH
KM/H
2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
MAY 2005



53 Additional Warning Label



54 Brake Fluid Reservoir Label

7.0 INSTRUMENT CALIBRATION (12 MONTH MAXIMUM INTERVAL)

VEHICLE: 2005 Volvo S40 2.4l M; NHTSA NO.: C55900; DATE: 04/22/05

INSTRUMENT	SERIAL NUMBER	CALIBRATION DATE	NEXT CALIBRATION
Data Acquisition System - Link DAS 2030	975016	02/28/04	08/30/06
Computer – Dell Latitude/Link Engrg.	TRC-43207	Not Applicable	Not Applicable
Software - Link Engrg. Rev Data	TRC Propr.	NA	NA
LF Torque Wheel	Not Utilized		
RF Torque Wheel	Not Utilized		
LR Torque Wheel	Not Utilized		
RR Torque Wheel	Not Utilized		
Stopwatch – Accusplit	SW ST03	07/16/04	07/16/05
Tire Pressure Gauge – Dill	AG-034	04/27/04	04/27/05
Voltage Multimeter – Dana 4300	M-108639	02/07/05	02/07/06
Pedal Force Transducer – Sensor Devel.	LC-169755	Each Test	Each Test
Asst. Pipe-Handle Steel Weights - Ohaus	LB-0002	06/22/04	06/22/05
Park Brake Force Transducer – Interface	41721	Each Test	Each Test
LF Hydraulic Pressure Transducer	Not Utilized		
RF Hydraulic Pressure Transducer	Not Utilized		
LR Hydraulic Pressure Transducer	Not Utilized		
RR Hydraulic Pressure Transducer	Not Utilized		
Accelerometer - Setra (+ or – 15 g) 141A	A-1055763	Each Test	Each Test
Fifth Wheel – ADAT DSR-06 Radar	140.0119	Each Test	Each Test
Wind Velocity/Direct. – Davis Model 6410	041008N03	11/23/04	11/23/05
Ambient Temp. Gage–Davis Model 6150C	B10910A01	11/23/04	11/23/05
LF Brake Thermocouple - Temprel/Link	T52-0B-24K	Ea. Test w/Link	Ea. Test w/Link
RF Brake Thermocouple - Temprel/Link	T52-0B-24K	Ea. Test w/Link	Ea. Test w/Link
LR Brake Thermocouple - Temprel/Link	T52-0B-24K	Ea. Test w/Link	Ea. Test w/Link
RR Brake Thermocouple - Temprel/Link	T52-0B-24K	Ea. Test w/Link	Ea. Test w/Link
Lock-up Detection System	TRC Propr.	Each Test	Each Test
Vehicle Weight – Toledo/Mettler Scales JAGXTREME 3000000, (Bldg. 70)	SN 5225831-5JC	02/06/05	05/06/05

QUALITY ASSURANCE_____

DAILY CALIBRATIONS (1 of 3)

Vehicle: 2005 Volvo S40 2.4l M NHTSA No.: C55900

Deceleration Calibration Data for Unit 5355
Desired full scale value is: 9.81 m/s/s
Allowed deviation is: + or - 0.15 m/s/s

		"Date"	"Time"	Zero	Cal	
		"stp"	"stp"	"Decel"	"Decel"	
Accelerometer	Level to zero, then tilt to full scale	4/25/2005	9:22:32	0.02	9.81	PRE-TEST CAL.
		4/26/2005	8:41:39	0.01	9.79	
		4/28/2005	8:18:03	-0.02	9.76	
		4/28/2005	15:22:08	0.04	9.73	
		4/29/2005	8:45:07	0.03	9.85	
		4/29/2005	16:04:58	0.05	9.83	
		5/2/2005	9:03:02	0.00	9.78	
		5/2/2005	15:20:44	0.00	9.81	
		5/3/2005	10:40:07	-0.03	9.79	
		5/3/2005	11:29:26	-0.02	9.82	
		5/4/2005	11:08:36	0.00	9.81	POST-TEST CAL.

Pre-Test Linearity Check 04/25/05

Actual (m/s/s)	Rec. (m/s/s)
0.0	0.0
3.0	3.0
6.1	6.1
9.8	9.8

Post-Test Linearity Check 05/03/05

Actual (m/s/s)	Rec. (m/s/s)
0.0	0.0
3.0	3.0
6.1	6.1
9.8	9.8

Distance Calibration Data for Unit 5355
Desired full scale value is: 1000 m
Allowed deviation is: 3 m

		"Date"	"Time"	Distance for	
		"stp"	"stp"	1000 meters	
Light beam distance sensor	Drive from 0 to 100 to 0 km/h on a measured kilometer	4/25/2005	13:51:18	1000.2	PRE-TEST CAL.
		4/26/2005	8:56:32	999.5	
		4/28/2005	8:30:11	997.7	
		4/28/2005	15:28:23	997.1	
		4/29/2005	8:51:00	998.1	
		4/29/2005	16:10:30	996.6	
		5/2/2005	9:10:59	997.2	
		5/2/2005	15:26:29	997.9	
		5/3/2005	10:44:39	997.5	
		5/3/2005	11:36:59	997.4	POST-TEST CAL.

DAILY CALIBRATIONS CONTINUED (2 of 3)

VEHICLE: 2005 Volvo S40 2.4l M NHTSA No.: C55900

Wheel Tachometer Calibrations for Unit 5355
Wheel tachometer calibrations: all wheel speeds should be 15 km/h

		"Date"	"Time"	Zero	@15km/h	Zero	@15km/h	Zero	@15km/h	Zero	@15km/h	
		stp	stp	LF	LF	RF	RF	LR	LR	RR	RR	
Wheel lock detector	While at a standstill, check zeros. Drive vehicle at approx. 15 km/h and engage zero speed switch for each wheel	4/28/2005	9:58:26	-0.1	16.9	0.0	15.8	0.0	16.0	0.0	16.3	PRE-TEST CAL.
		4/28/2005	15:25:00	0.0	16.7	0.0	16.0	0.0	16.6	0.0	17.8	
		4/29/2005	8:50:03	0.0	16.5	0.0	15.6	0.0	15.7	0.0	16.2	
		4/29/2005	16:07:21	0.0	17.6	0.0	16.0	0.0	17.9	0.0	17.0	
		5/2/2005	9:06:16	0.0	17.6	0.0	15.7	0.0	17.2	0.0	17.0	
		5/2/2005	15:28:41	0.0	17.8	0.0	15.4	0.0	16.5	0.0	16.7	
		5/3/2005	10:46:57	0.0	18.9	0.0	16.7	0.0	18.1	0.0	17.1	
		5/3/2005	11:31:45	-0.1	17.3	-0.1	16.2	0.0	16.6	0.0	16.6	POST-TEST CAL.

When driven over 15 km/hr and the wheel tach generators are shunted to zero volts, does the graphical screen indicate wheel lock at each wheel position?: __X__ Yes, _____ No.

Note: The wheel tach calibrations did not occur until after the Burnish was complete.

Pedal Force Meter Calibration for Unit 5355
Target shunt calibration is 388 N

Desired recorded value is: 388 N
Desired recorded actual force calibration check value is: 498 N
Allowed deviation is: 6.5 N

		"Date"	"Time"	Zero	Cal Val	
		stp	stp	Force	Force lb	
Service brk. pedal effort	Driver engages a fixed shunt cal switch.	4/25/2005	9:19:48	-0.7	498.8	PRE-TEST CAL.
		4/26/2005	8:42:27	-0.1	388.8	
		4/28/2005	8:21:45	-0.5	388.6	
		4/28/2005	15:23:41	-1.0	388.5	
		4/29/2005	8:46:29	0.0	388.9	
		4/29/2005	16:05:32	-0.3	388.6	
		5/2/2005	9:04:27	-0.5	388.4	
		5/2/2005	15:21:06	0.0	388.7	
		5/3/2005	10:41:19	-0.2	388.6	
		5/3/2005	11:30:30	-2.2	388.8	
		5/4/2005	11:06:50	0.1	498.2	POST-TEST CAL.

Pre-Test Linearity Check - 04/25/05

Actual Force (N)	Recorded Force (N)
0	0
222	222
445	445
498	498

Post-Test Linearity Check - 05/03/05

Actual Force (N)	Recrdd Frc(N)
0	0
222	222
445	445
498	498

DAILY CALIBRATIONS CONTINUED (3 of 3)

VEHICLE: 2005 Volvo S40 2.4I M NHTSA No. C55900

Dynamic Speed Calibration for Unit 5355

Desired speed value is: 100 km/h
Allowed deviation is: 1.6 km/h
Desired time value is: 36 seconds
Allowed deviation is: + or - 0.6 seconds

Light beam speed sensor

Drive vehicle at a steady 100 km/h through a kilometer.

"Date"	"Time"	"Speed"	Time"	
stp	stp	km/h	sec	
4/25/2005	13:54:32	99.7	35.89	PRE-TEST CAL.
4/26/2005	8:54:30	100.1	36.31	
4/28/2005	8:28:18	100.2	36.25	
4/28/2005	15:27:12	100.2	36.21	
4/29/2005	8:48:20	100.2	36.12	
4/29/2005	16:09:24	100.3	36.06	
5/2/2005	9:09:05	100.3	36.09	
5/2/2005	15:24:33	91.8	36.18	
5/3/2005	10:42:39	100.5	35.90	
5/3/2005	11:33:53	100.6	36.12	POST-TEST CAL

APPENDIX A

Copy of Manufacturer's Sticker

VOLVO
for life

Volvo Cars of North America, LLC
Irvine, CA 92618

Make & Model: 2005 VOLVO 4 Door Sedan
Model Description: S40 2.4I M
Vehicle ID No: YV1MS382152051631
Color: 019 Black Paint
Port of Importation: Baltimore, MD
Delivered by: Truck

Authorized Retailer:
DWYER & SONS VOLVO-SUBARU
3055 E. WEST MAPLE ROAD
COMMERCE TOWNSHIP, MI 48390

Importer's Suggested List Price P.O.E.:	$ 23,260.00
Destination Charge	685.00
VOLVO "On-Call" Road Assist	
Total Suggested Retail Price:	$ 23,945.00

Power Performance · Occupant Safety · Comfort Convenience

ENGINE & TRANSMISSION
- 2.4 Liter, 5 Cylinder, Normally Aspirated, All Aluminum Engine w/DOHC Variable Valve Timing
- 168HP @ 6000 RPM & 170 Lbs.Ft.of Torque
- Front Wheel Drive, 5 Speed Manual Tr...

SUSPENSION/CHASSIS/STEERIN...
- Front Independent Strut Sus...
- Multi-Link Rr Suspension ...
- 4-Wheel Power Assis... (...ated) w/Anti-Lock Brakin... Distribution (EBD), Emergency Brake Assis...
- Speed-Dependent, Power Assisted, Electro-Hydraulic Rack & Pinion Steering
- 16" Alloy Wheels with 205/55R/16 All Season Tires

SAFETY & SECURITY
- Stability Traction Control (STC)
- Unibody Construction with Integral Passenger Safety Cage/High Strength Steel (HSS) Components and Energy Absorbing Impact Structures
- Volvo Inflatable Curtain Side Impact Head Protection System (VIC)
- Volvo Side-Impact Protection System (SIPS) Including Driver and Front Passenger Side-Impact Airbags
- Driver ... er Dual Stage Supplemental ... System
- Weight Sensor for Front Passeng...
- Front ...
- 5 3-...
- ISO Fix Baby/Child Seat Anchorage ...
- Open Door Warning System / Rear Door Child Safety Locks
- Emergency Trunk Release Handle / Rear Fog Lights
- Safe Approach & Home Safe Perimeter Lighting System
- Daytime Running Lights w/Projector Type Low Beams

COMFORT & CONVENIENCE FEATURES
- Dynamic T-Tec Seating Surfaces
- Ultra-Slim Center Control Panel / Manual Climate Cntrl
- Intelligent Driver Information System (IDIS)
- Personal Settings for Locking, Audio & Climate Control
- Power Windows with Auto Up/Down on All Positions
- Heated, Power Outside Rearview Mirrors
- Turn Signal Indicators in Outside Rearview Mirrors
- 8-Way Adjustable Driver's Seat
- Foldable, 2-Split 60/40 Rear Seat
- Door Mounted Central Locking Function (Driver's Door)
- ... Unlock
- ... tral Locking
- ... ote Control w/Alarm
- ... djustment
- ... eel / Cruis... ol
- ... rests
- 4 Cupholders: 2 Front / 2 Rear
- Dust/Pollen Filter for Passenger Cabin
- Outside Ambient Temperature Gauge
- Footwell Lights / Reading Lights
- Clothing Hook / Pen, Credit Card, & Coin Holders
- Color-Coordinated Bumper & Side Body Moldings
- Front Door Tread Plates / Sill Plates
- 2-Step Door Opening / Plush Floor Mats
- Heated Rear Window

AUDIO EQUIPMENT
- AM/FM Stereo Radio and Single-CD Player
- 4 X 20 Watt Amplifier, 6 Speakers
- Active Sound Control, Scan, Autostore

ENVIRONMENT
This vehicle is equipped with PremAir - A coating on the radiator that helps transform ground level ozone into oxygen as you drive. (PremAir is a registered trademark of Engelhard Corp.)

The price shown does not include Gasoline, License and Title Fees, State and Local Taxes and Dealer Installed Options and Accessories. The factory reserves the right to modify price, designs and equipment without previous notice.

DELIVERY ...
DWY...
3055 ...
COMMERCE TOWN...

VEHICLE ...
Type & Ch...
Y...
...
VIN: YV1MS3...

ENVIRONMENTAL PARTNERSHIP

... manufactured ... compatible manner. ... handle and ... micals ... ance with ... ished ... our environment ... when we do it toge...

PARTS CONTENT INFORMATION

FOR VEHICLES IN THIS CARLINE: VOLVO SERIES
U.S./CANADIAN PARTS CONTENT: 1.4%
MAJOR SOURCES OF FOREIGN PARTS CONTENT:
SWEDEN: 22%
...
... BELGIUM
COUNTRY OF ...
... SWEDEN
... SWEDEN
Note: Parts content does not include final assembly, distribution, or other non-parts costs.

WARRANTY

Factory Scheduled Maintenance to 3 Years/36,000 Miles
... Coverage
144 Month Corrosion Protection
* Unlimited Mileage *
Refer to Warranty ... for ... Limitations

SMOG EMISSIONS INFORMATION

The Smog Index of this vehicle is: 0.3...
The Smog Index of the average new vehicle is: 0.80

CLEANER ... MORE POLLUTING

Note: The Smog Index (SI) indicates the relative level of smog-forming pollutants emitted by the vehicle. The lower the SI, the lower the vehicle's emissions.

YV1MS382152051631

Compare this vehicle to others in the FREE GAS MILEAGE GUIDE available at the dealer.

CITY MPG 22

HIGHWAY MPG 29

Fuel Economy Information
DOE EPA

Actual Mileage will vary with options, driving conditions, driving habits, and vehicle's condition. Results reported to EPA indicate that the majority of vehicles with these estimates will achieve between 18 and 26 mpg in the city and between 24 and 34 mpg on the highway.

MODEL: 2005 Volvo S40 FWD, ... 5 Speed Manual Transmission, ... Fuel Injection.

For Comparison Shopping: all vehicles classified as ... have been issued mileage ratings ranging from ... to ... mpg city and ... to ... mpg highway.

ESTIMATED ANNUAL FUEL COST
$ ...

See Gas Mileage Guide for Details at www.fueleconomy.gov

APPENDIX B

Discussion on Data

DISCUSSION ON DATA

Symbols for Brake Components

4	-	4 Wheel	G	-	Groan	DL	-	Deceleration (State FPSPS)
X	-	Skid	SQ	-	Squeal	PF	-	Pedal on Floor
L	-	Left	SQK	-	Squeak	SCP	-	Shoe Scrape
R	-	Right	PO	-	Pinchout	RB	-	Rubber Banding
R	-	Rear	P	-	Pull	O	-	Odor
F	-	Front	R	-	Shudder	NOX	-	No Skid
B	-	Both	M	-	Momentary			

INT or INIT	-	Initial Part of Stop
MID	-	Middle of Stop
END	-	End of Stop

All stops were made manually.

APPENDIX C

Contractor's Comments
Procedure Modifications
and
Test Facility

Comments for vehicle C55900.

For all recorded decelerations:
The recorded *average* deceleration values for the tests are slightly lower than that which is required or targeted for certain test sections. However, in all cases and in reality, the driver maintained the correct required/target deceleration values for the majority of time for each of those stops. The recorded deceleration is acquired from the moment the service brake pedal is moved until the vehicle reaches zero speed. Therefore, the time needed to achieve the target deceleration (rise time) and the time the vehicle goes from the target deceleration to zero (fall time) is included in the average deceleration calculation. The rise and fall times were added to the entire length of the stops. Hence the recorded average deceleration values were generally and slightly less than the required/target deceleration values.

For Data Sheets 16 & 22 – Antilock Functional Failure at LLVW and GVWR, respectively, the ABS and the Electronic Brake Distribution (EBD) are integral. Failing the ABS also fails the EBD. The EBD cannot be failed separately. The vehicle does not posses any form of variable proportioning. Therefore, Data Sheets 17 and 23 are not included.

For Data Sheets 20 and 21, the Hydraulic Circuit Failures, the tests were performed in the following order: Data Sheet 21 and 20. This was due to the difficult accessibility of accessing the master cylinder output ports.

Due to the master cylinder's design, the lab was unable to safely disassemble it in order to measure the piston(s) diameters. For documentation, the number engraved on the master cylinder's forward facing end was: 152W4. The manufacturer's response stated both the Primary and Secondary master cylinder pistons were 23.81 mm.

The test vehicle possesses an electric pump that provides vacuum to the brake booster. The hose from this electric vacuum pump to the brake booster was disconnected and sealed to simulate Inoperative Brake Power Assist Unit. Also, performed 10 static applications of the service brake to deplete reserve.

During the "Heating Snubs", snubs six through 11, the driver experienced difficulties with the instrumentation, which were repaired, "on-the-fly". This resulted in some errant time intervals.

7.5-MILE TEST TRACK

The 7.5-mile test track encloses a 1,600-acre area, one mile wide and 3.5 miles long.

The track has a downward grade, north to south, of 0.228 percent and a cross slope in the straightaways of 3/16 inch per foot. The 1.88 mile long straightaways flow into transition areas 2,300 feet in length and then into 5,275-foot long curves with a constant radius of 2,400 feet. The 36-foot wide straightaways and the 42-foot wide curves provide three test lanes. Paved berms, 12 feet in width, border the straightaways and the inside of the curves.

As a vehicle moves toward the outside of the track in the curves, it encounters a progressively steeper bank. The inside lane (or "slow" lane) has a bank of 10 degrees allowing a neutral speed of 80 mph with no side forces. In the center lane, the slope increases to 19 degrees resulting in a neutral speed of 110 mph. The outside lane's 28-degree bank allows a 140 mph neutral speed. Rimming the outer lane is a seven-foot safety lane culminating in a 36-degree slope at the guardrail.

The facility is paved with Portland cement concrete. It carries a maximum single axle load of 36,000 pounds and a maximum tandem axle load weight of 48,000 pounds. Special provisions can be made for heavier weight loads.

With 22.5 lane miles, our track will accommodate many vehicles simultaneously. Research which utilizes the track includes component performance and durability studies, brake tests, aerodynamic studies, fuel economy studies, drive line efficiency tests, and the determination of vehicular acceleration and cruise characteristics. In addition, it supports maximum speed determination, road load power, noise and emission measurements and tire durability test programs.

The 7.5-mile test track can be used in conjunction with other facilities at TRC. It provides an excellent area for pre-test conditioning of equipment such as brake burnishing, tire break-in, and vehicle warm-up.

TRC SKID PAD

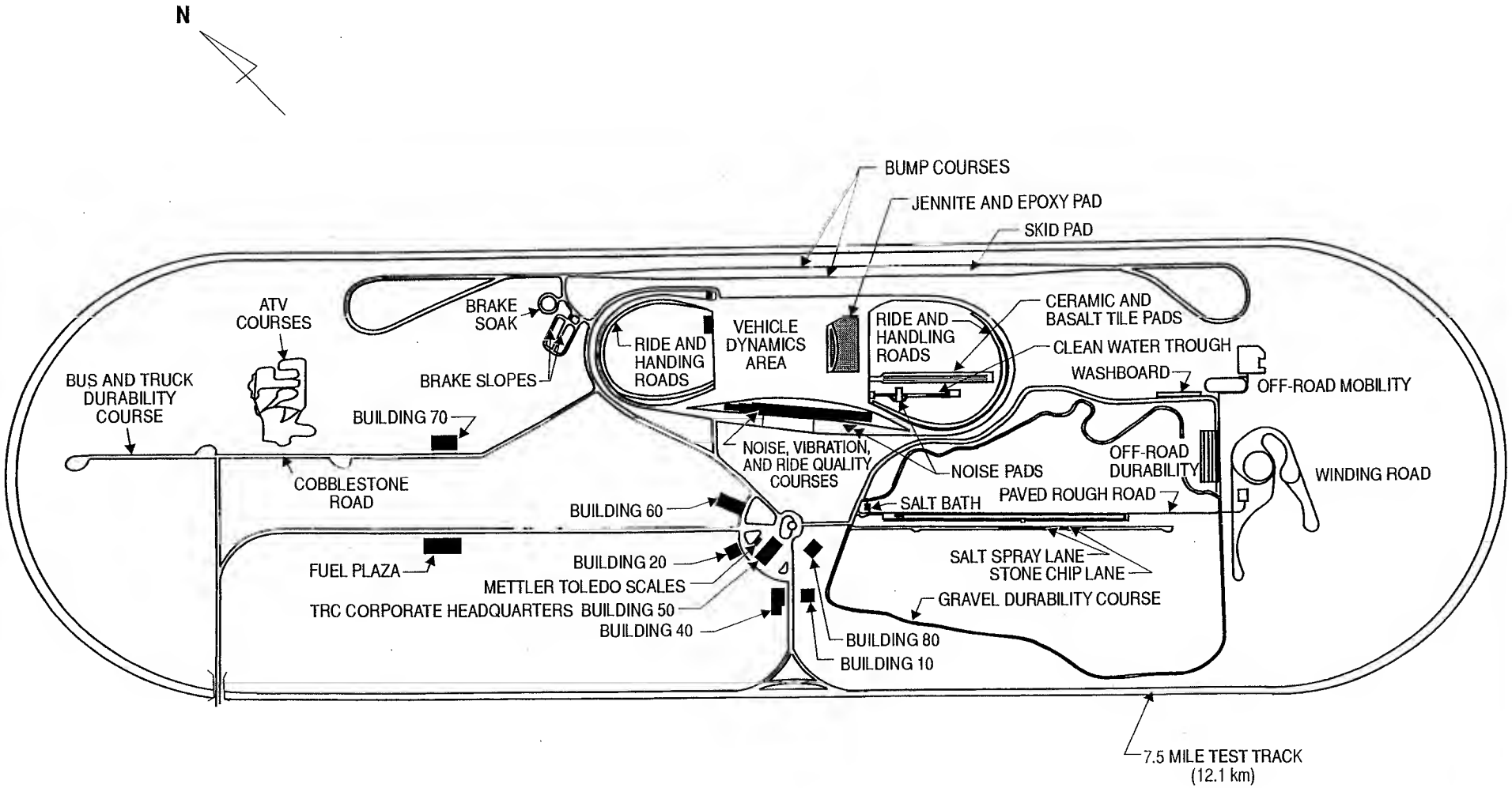
The Skid Pad is a test facility which is utilized primarily for the evaluation of tire and brake systems.

The overall dimensions of the pad are 9,000 feet by 84 feet with loops on the north and south ends. Both turnaround loops have a 309-foot radius and are 16 feet wide with a 25 percent super elevation. They will accommodate speeds of 45 mph with zero side force and 60 mph with .5 g's lateral acceleration. The acceleration/deceleration lanes at each end are 3,280 feet in length.

A test area of 210,000 square feet is situated in the center of the skid pad containing several test pads with varying surface textures. Skid numbers in this area range from 30 (wet) to 80 (dry).

The skid pad is paved with Portland cement. The load capacity of the skid pad is 36,000 pounds maximum single axle weight and 48,000 pounds maximum tandem axle weight.

Varying surface textures in the main test area are ideal for testing tire and/or brake system performance on different surfaces as characterized by "skid numbers." The skid pad is also used for acceleration studies, aerodynamics, rolling resistance, noise testing, and vehicle top speed determination.



NOT TO SCALE

TEST FACILITY DETAIL

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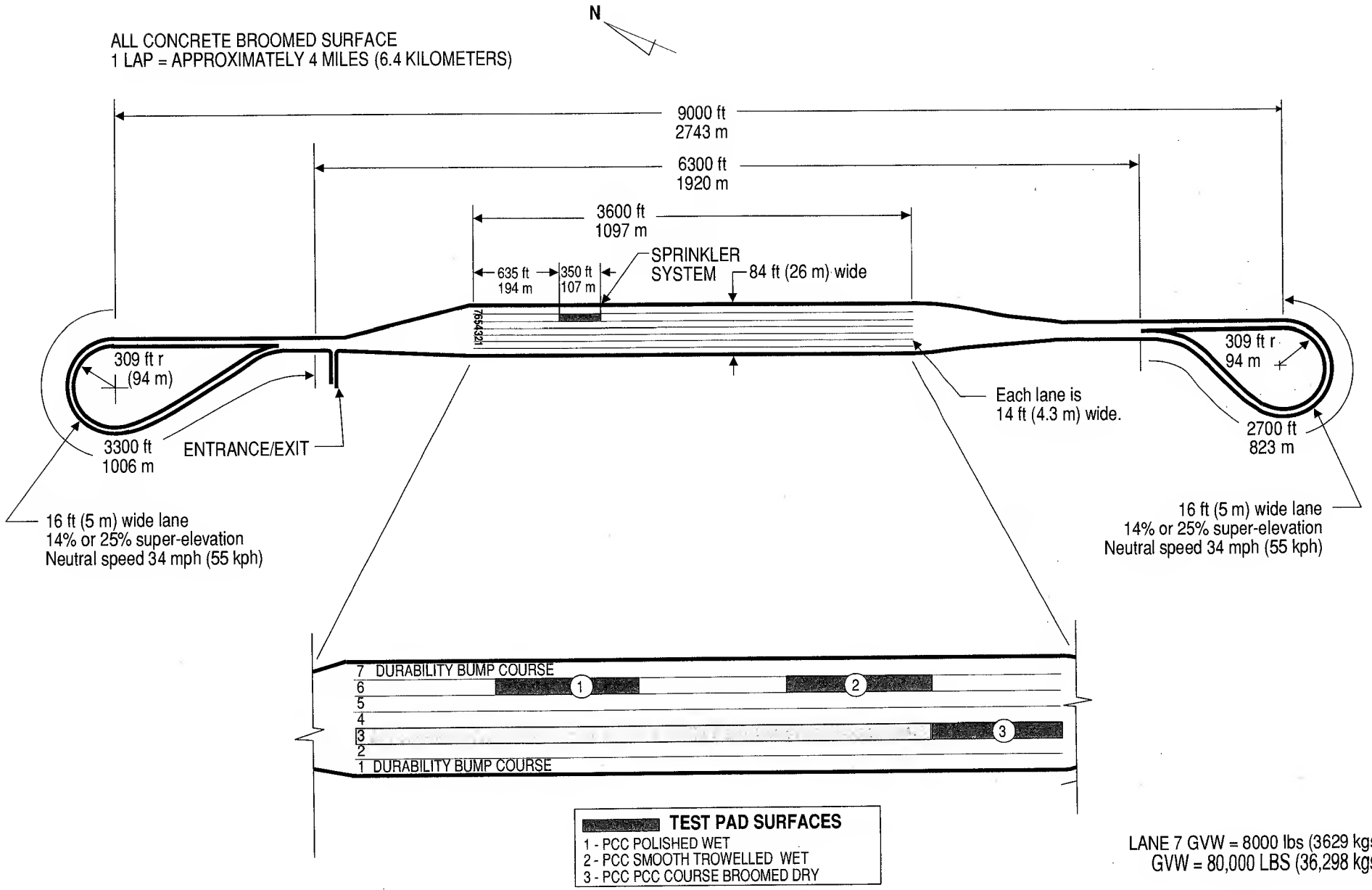
F-15 0601



NOTE: BUMP COURSES PARALLEL THE PERIMETERS OF LANES 1 AND 7.

Not to scale
All dimensions are approximate

SKID PAD

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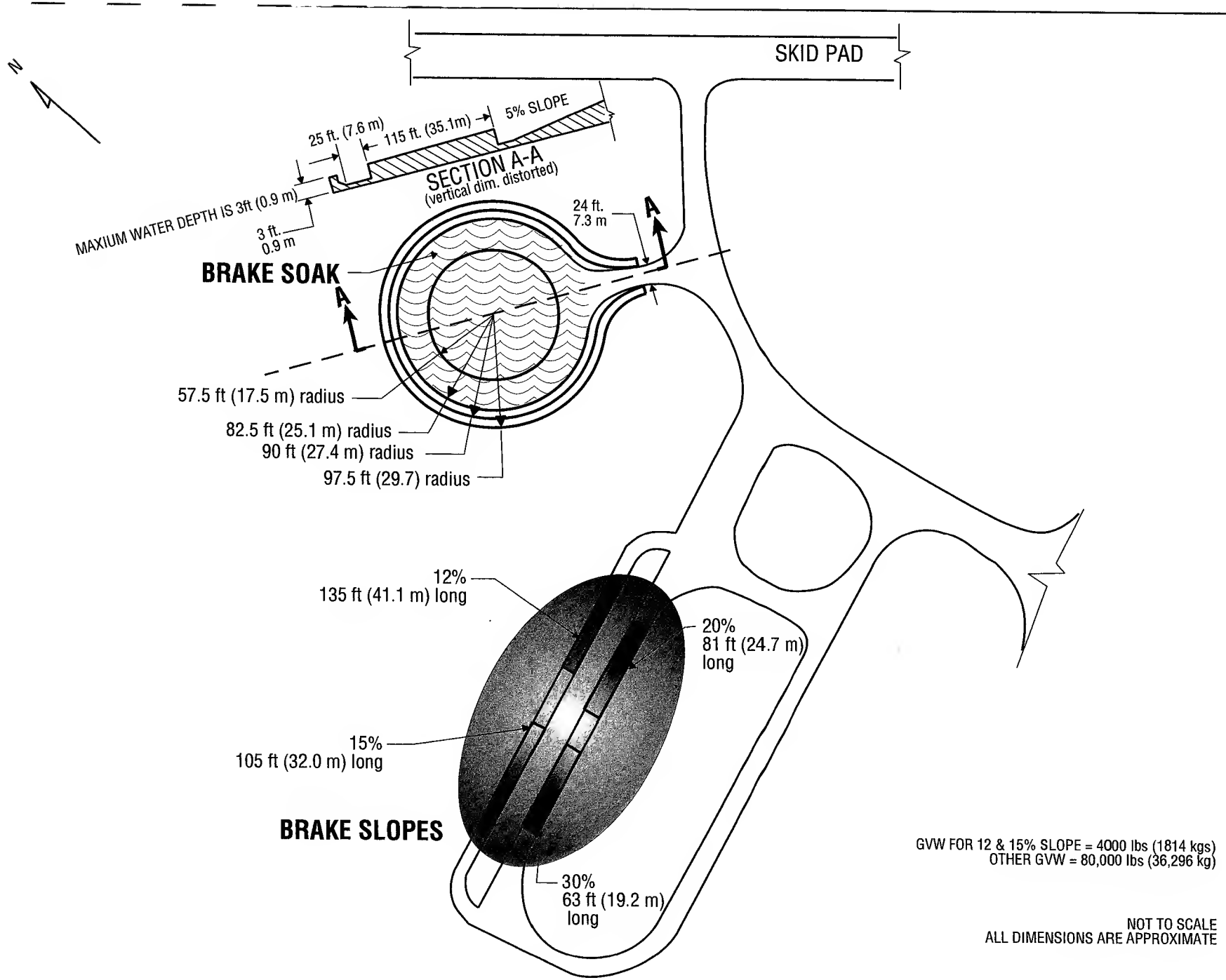

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BRAKE SOAK and BRAKE SLOPES

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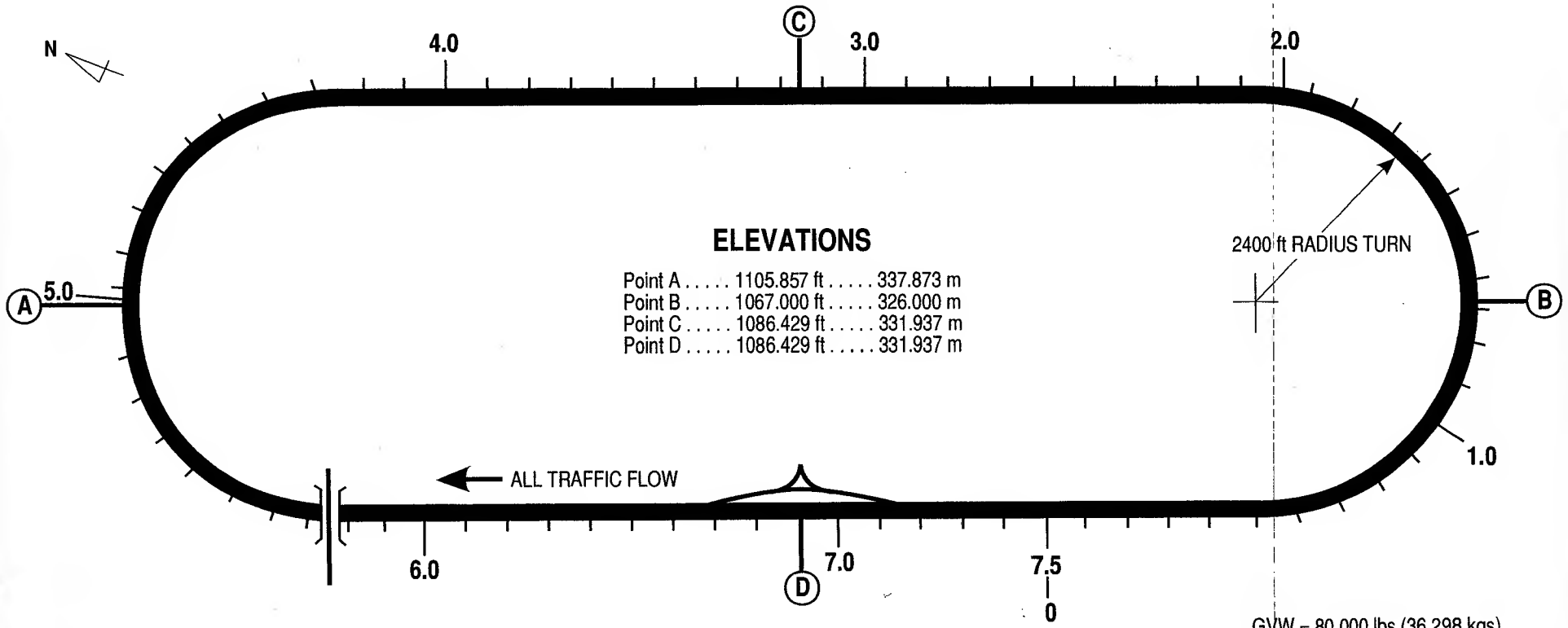
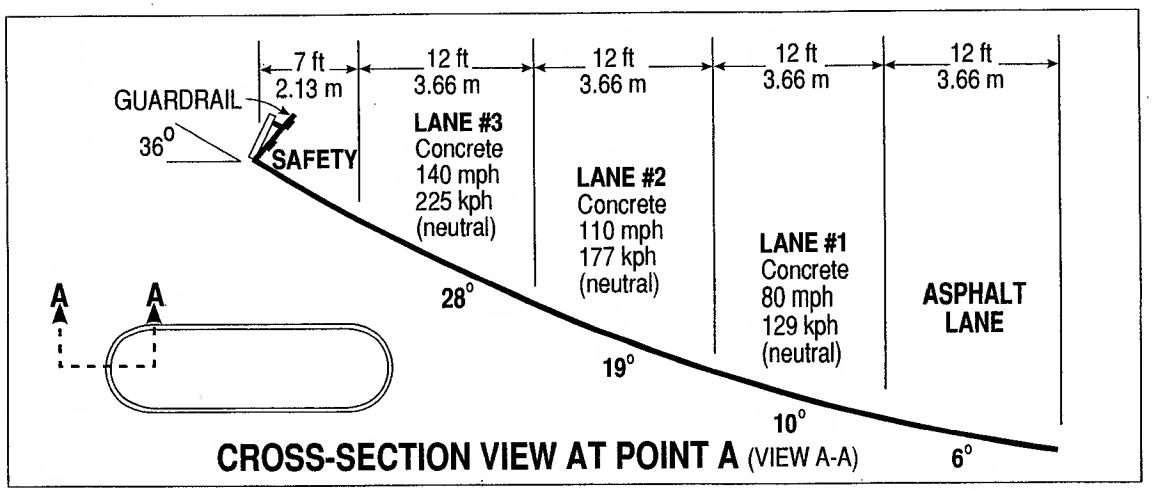


ELEVATIONS

Point A . . . . . 1105.857 ft . . . . . 337.873 m
Point B . . . . . 1067.000 ft . . . . . 326.000 m
Point C . . . . . 1086.429 ft . . . . . 331.937 m
Point D . . . . . 1086.429 ft . . . . . 331.937 m

GVW = 80,000 lbs (36,298 kgs)



CROSS-SECTION VIEW AT POINT A (VIEW A-A)

DISTANCES

Lane 3 . . . . . 7.539 mi . . . . . 12.133 km
Lane 2 . . . . . 7.521 mi . . . . . 12.104 km
Lane 1 . . . . . 7.507 mi . . . . . 12.081 km

Point A to Point B . . . . . 3.333 mi . . . . . 5.364 km
Point C to Point D . . . . . .947 mi . . . . . 1.524 km

NOT TO SCALE

7.5-MILE TEST TRACK

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APPENDIX D

Notice of Possible Non-Compliance

This vehicle (C55900) met the requirements of the FMVSS 135 standard.